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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone* 332)

Forthcoming Events.

FEBRUARY 13.

Institute of Metals (Birmingham Local Section):—Meeting in the James Watt Memorial Institute, Birmingham. "Age-Hardening Copper Alloys," Paper by Maurice Cook.

Institute of Metals (Swansea Local Section):—Meeting at Y.M.C.A. at 6.15 p.m. "Cracking and Fracture of Metals, with Special Reference to Service Breakages," Paper by Prof. F. Bacon.

Institute of Metals (North-East Coast Local Section):—Meeting at Armstrong College, Newcastle, at 7.30 p.m. "The Flow of Metals in the Extrusion Process," Paper by C. E. Pearson.

FEBRUARY 15.

Institution of Welding Engineers (North-Eastern Branch):—Meeting at Neville Hall, Newcastle. "Steelmaking as applied to Welding," Paper by H. Bull.

Institute of British Foundrymen.

FEBRUARY 10.

Scottish Branch:—Meeting at Royal Technical College, Glasgow, at 4 p.m. "The Value of Temperature Control in Metallurgical Practice." Paper by Prof. Robert Hay.

West Riding of Yorkshire Branch:—Works visit to Messrs. W. C. Holmes & Company, Limited, Huddersfield.

FEBRUARY 13.

Lancashire Branch (Burnley Section):—Meeting at Municipal College, Burnley, at 7.15 p.m. "Ironfoundry Practice Modernised," Paper by R. H. C. Weeks.

FEBRUARY 16.

Sheffield and District Branch:—Meeting in Grand Hotel, Sheffield, at 7.45 p.m. "Alloy Pig-Irons," Paper by J. H. D. Bradshaw.

Bouquets Instead of Brickbats.

Governments must sometimes reflect with sadness that it is impossible to please everybody. However large the majority, as soon as Government gets into office, criticism begins. Indeed, the only way to please everybody is to do nothing. The criticism is particularly acute when any question of money is involved, such as any kind of subsidy. The recent case of the purchase of the Codex is fresh in the mind of everyone.

The Government must therefore feel particularly pleased at the reception given to the recent Report of the Department of Scientific and Industrial Research. We have read dozens of press accounts and editorials on this, and we have yet to find an adverse criticism, or, indeed, anything but praise for the administration by the Department of the funds entrusted to it and for the work that is done by the various agencies concerned. As an engineering contemporary concludes, the research associations "have proved their capacity usefully to employ much larger incomes than those with which they have up to now been entrusted."

The industry, of course, has its own body, the Cast Iron Research Association, and is directly or indirectly concerned with several others, according to the range of the particular works concerned, notably the Non-Ferrous Research Association, the Iron and Steel Industrial Research Council. As users, the industry is concerned with several others, such as the Refractories Research Association and the Department's Fuel Research Board. But when this matter is examined carefully, it will be found a general rule that it is difficult to persuade users to support these Associations systematically. Indeed, the makers in a given industry might properly object to users dictating policy to any extent, in which connection, we may observe, that whoever furnishes the money so urgently needed is likely to want whatever measure of control may legitimately accompany it. To revert to the user, the support offered by the gas industries to the Refractories Research Association is a striking example of the interest of users. A recent Paper by a prominent technologist in that industry declares that the gas industry's interest in cast iron is almost as great as its interest in refractories.

On the whole, the Associations form a closely-knit group, which would as a group be harmed by the disappearance of one or more of their number, for one depends on another; progress in an industry may be dependent on an advance in scientific-instrument manufacture, and so on. As citizens, we are greatly concerned with such matters as textiles, boots and shoes, food, and thus we can escape the influence of scientific advance in no department of our lives—private or otherwise. Those disinterested persons who set out a few months ago to rouse public opinion to the value of research thus find it, in fact, already roused.

The Flood of Literature.

From time to time complaints are made in the technical Press of the overwhelming flood of literature which is annually poured forth by scientific societies and institutions. The despairing cry goes up: "How can we be expected to keep in touch with this enormous output of Papers?" and the prayer is answered to some extent by the rigid curtailment of anything but the purely experimental type of Paper. If we pause a moment to consider the position, can it really be maintained that there is an overwhelming flood of literature in the true sense of the term, or that the half-hearted way in which the position is being tackled bears any resemblance to a logical solution?

Generally, it is found that the keen technical man eagerly consumes all the literature he can obtain which is of any real value, but at the same time it cannot be denied that a great proportion of the facts and figures which clutter the voluminous transactions of certain of the more academic societies are redundant to the needs of the scientific and technical world. Many of these writings-up of uninspired experimental work, often undertaken for the sole purpose of acquiring a higher degree, pass into the limbo of forgotten literature, unhonoured, undiscussed and unwanted. Admittedly, they may serve a purpose at some future date, but to-day they are of interest to at most half-a-dozen workers in the same field. If the situation is so grave that publication must be restricted to a minimum, it would surely be sufficient to publish an abstract of such Papers, giving the pertinent idea or the original method developed by the author, whilst copies of the MS. could be retained for loan to interested fellow-workers.

At the same time, and in the alleged interests of economy, our learned societies are religiously

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setting their faces against Papers of a discursive or critical nature, and experimental work is invariably demanded by publication committees, sometimes without due regard to the material value of such work. That this attitude, if rigorously maintained, cannot but lead to stagnation and loss of interest is clear from an object lesson recently provided by one scientific institute. The Council of this particular body found it necessary a short time ago to issue a whip to its members, calling for better attendance at the general meetings, where Papers of the research and experimental type only are read. On the other hand, the meetings of the local sections, which invariably have before them Papers dealing with the experience of mature workers in their particular spheres, or Papers giving critical or thought-provoking surveys of fairly wide topics, are in almost every case full to overflowing.

Obviously, a place in the literature must be found for genuine and valuable scientific Papers, but this fact does not in any way lessen the value of the descriptive or discursive Paper, which generally has the effect of stimulating thought and of presenting the points of view and ideas of an experienced technical man. In this respect such bodies as the Institute of British Foundrymen and the provincial metallurgical and engineering associations are rendering a great service to the industries they represent. By their dissemination of Papers which present new points of view or discuss practical developments, they are providing their membership with food for thought and with inspiration for the conduct of their own technical affairs. As regards the economic side of publication, is it not reasonable to assume that a technical man will more readily support a body which provides this type of literature than one which merely serves him with a record of a series of uninteresting investigations with no leaven of intelligent comment and criticism? The learned societies would do well to take a leaf from the book of such bodies as the Institute of British Foundrymen if they have any desire for their publications to become "best-sellers."

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Dearth of Foundry Students.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I would be very grateful if you would allow me space to draw attention to what I believe to be a serious state of affairs in connection with the training of apprentices in the patternmaking and foundry industries.

We in the London County Council School of Engineering and Navigation find great difficulty in obtaining sufficient recruits to maintain our classes in Patternmaking and Foundry Practice up to the minimum margin at which the classes may be allowed to function. The London County Council has recently laid down new equipment, and thoroughly modernised our workshops, and it seems a great pity that the fullest benefit cannot be obtained therefrom.

We have tried to interest the employers in this neighbourhood in our work, so that they may stimulate their employees to attend here, but with little success.

You will remember that in May, 1931, the Institute of British Foundrymen circularised all their members in connection with the then new City and Guilds of London Institutes examinations in these subjects, and if I may quote from that letter, I read "These courses and examinations constitute the most important step which has yet been taken towards the technical education of foundrymen. Their success will depend entirely upon the number of students presenting themselves."

I understand from my colleagues in technical education that this experience of mine is also felt in nearly all parts of the country, and it seems to me, Sir, that a fresh campaign is necessary in order that the object of the new examinations and courses should be realised.

A further disquieting feature is that I find it extremely difficult, in fact almost impossible, to persuade my Junior Technical boys to enter the patternmaking and foundry trades. An employer in my district tells me that his greatest trouble is to secure *any* recruits, let alone efficient ones.

To one who is seriously concerned with the technical education of the young engineer, these facts are very disturbing, and I shall be glad to hear the views of your readers on this matter.

We in this school are anxious and eager to do our share and our examination record proves the efficiency of our methods, but we cannot succeed without students.—Yours, etc.,

GEORGE THOMPSON,
M.Eng., A.M.I.Mech.E., M.I.Mar.E.,
Head of Mechanical Engineering Department.
London County Council School of Engineering and Navigation,
High Street, Poplar,
London, E.14.
January 26, 1934.

Scotland's Largest Horizontal Diesel Engine.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue of January 11, under the heading "Trade Talk," we notice a paragraph stating that Messrs. C. F. Wilson & Company (1932), Limited, of Aberdeen, have completed the second of what they claim to be the largest horizontal diesel oil engines made in Scotland. The engines are stated to be twin-cylinder and to measure 12 ft. by 12 ft. by 7 ft. high, inclusive of flywheel; the power is given as 120-130 h.p. and the weight 10 tons each.

While we wish to congratulate Messrs. Wilson on the successful construction of these engines, we think it is necessary to point out that these are by no means the largest horizontal oil engines made in Scotland. As long ago as 1927 we constructed and sent to Australia a single-cylinder horizontal oil engine, measuring 15 ft. 6 in. by 10 ft., and which had an 8 ft. 6 in. dia. flywheel, the engine weighing 15 tons without accessories and developing up to 120 b.h.p. We also despatched last year to Stornoway a double-cylinder horizontal diesel engine, measuring 13 ft. by 11 ft. with a 6 ft. 6 in. dia. flywheel, the total weight of the engine without accessories being over 11½ tons, and the engine developing up to 138 b.h.p. We have also made a large number of single-cylinder horizontal diesel oil engines developing 92 b.h.p.

In view of the specific claim made by Messrs. Wilson, perhaps you would be so kind as to publish this information we now give you.—Yours, etc.,

JAMES SHANKS,
Director.
Alexander Shanks & Son, Limited,
Dens Iron Works,
Arbroath.

PRESIDING at the annual meeting in Johannesburg last month of the Manganese Corporation (1929), Limited, Mr. H. James Bowen, said that the company was compelled to cease operations in October, 1931, and there was nothing to justify any further mining activity until April of last year, when the acceptance of certain comparatively small orders rendered this course desirable. Since re-opening and up to the end of November, 1933, 12,300 tons of ore had been produced, and 22,330 tons shipped, the balance in excess of production being from stock. While this result was trivial compared with the output capacity of the mines, there was encouragement in the immediate outlook, and for the first quarter of 1934 the disposal of the present output was secured.

Random Shots.

Welding engineers visualise the time when the riveting squad will be but a memory in the shipyards of the Clyde, the Tyne and the other industrial rivers of Britain. They refuse to be discouraged by the somewhat disconcerting unwillingness of the shipbuilding unions to consent to the creation of a new body of trained men to be known as "shipyard workers." Rightly so. But why stop there! Why concentrate on the riveting mole-hill and ignore the mountainous ship-plate? Let's do away with ship-plates altogether! *Why not have cast-steel hulls?*

* * *

"Cast Steel for Economy" might well become the slogan of the shipbuilding industry. Instead of the laborious and intricate building up of steel plates and sections, which is at present the practice in our best shipyards, we should have substituted one clean job which, after the making of the mould, would be done in one operation. Think, too, of the elimination of noise which would be effected. Everybody knows what a bad effect noise has on the worker, reducing his efficiency, fraying his temper and generally retracting from his value as a citizen and a husband. Replace the steel plate with the casting ladle and you substitute for the clanging of hammers and the din of the riveting tool the harmless and soothing sound of molten metal running into the mould.

* * *

The naval architect may protest that cast steel lacks the strength of the rolling-mill product. Well, are ships deliberately built with the idea that one of their functions is to crash into other moving and stationary objects? And if they break occasionally, what of it? Has a steel plate never been known to fracture? Is the tea-cup designed to withstand careless impact with the tiled floor or the kitchen sink? Are promises made to be broken? Is——? but perhaps that is enough.

MARKSMAN.

Institute of Metals.

The Twenty-Sixth Annual General Meeting will be held in the Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1 (by kind permission of the Council of the Institution), on March 7 and 8. The annual dinner will be followed by a dance, which will be continued until 1 a.m.: Pilbeam's Band has again been engaged. The price of tickets for the dinner and dance—exclusive of wines—is 15s. Application for tickets may be made now by members who desire to reserve seats or tables for the dinner.

Election of Council.

As only sufficient nominations to fill the vacancies announced at the last General Meeting have been made, no ballot will be necessary, and the following members, who have been nominated for election on the Council, will be declared duly elected at the Annual General Meeting:—*President:* H. Moore, C.B.E., D.Sc., Ph.D.; *Vice-Presidents:* A. G. C. Gwyer, Ph.D., Warrington, Prof. D. Hanson, D.Sc., Birmingham, H. C. Lancaster, London, E. L. Morcom, M.A., Birmingham; *Treasurer:* John Fry, London; *Members of Council:* Prof. J. H. Andrew, D.Sc., Sheffield, Engineer Vice-Admiral H. A. Brown, C.B., London, H. W. Brownsdon, M.Sc., Ph.D., Birmingham, H. H. A. Greer, Glasgow, J. L. Haughton, D.Sc., Teddington, Prof. R. S. Hutton, D.Sc., M.A., Cambridge, Kenneth Gray, Sheffield.

May Lecture.

Prof. E. K. Rideal, F.R.S., has accepted the Council's invitation to give the next May Lecture. This will be delivered in the Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, on Wednesday, May 9, at 8 p.m., when Prof. Rideal will lecture on "Metals and Gases."

Some Points in Electric Steel Making.*

By Victor Stobie (Past-President of the Institute of British Foundrymen).

The rise and development of electric steel is one of the romances of the steel industry. The regular commercial manufacture of electric steels in arc furnaces commenced on the Continent in 1907. Previously, and later, experiments in the electric melting and refining of steel in low-frequency induction furnaces were made in various parts of Europe; but these never attained success, and, with a few rare exceptions, only the arc and high-frequency types of furnaces are now used in steelworks.

The commercial production of electric steel in Great Britain commenced in 1910. At that date very little was understood of the characteristics of either the furnace or the steel produced, except by one or two enthusiasts who had studied the problem on the Continent. The early history of many successful scientific industries is a sequence of optimism, pessimism, enthusiasm, heavy losses, bulldog tenacity, and ultimate success. The history of the manufacture of electric steels and the designing of the most favourable plant for its production follows this, by no means royal, road.

The searching after causes in realms then entirely unknown to steelmakers, and the, apparently, constantly conflicting results obtained were, undoubtedly, most engrossing at the time to the handful of metallurgists who were probing the subject. From those early years has sprung a systematised routine of manufacture which enables steels of remarkably tough nature to be produced.

Electric steel is admittedly freer from impurities, including slag and gas occlusions, than steel made by any other process. For a given tensile strength, the resistance to impact of well-made electric steels is considerably higher than that of any other type of steel. For automobile and aeroplane engines, gears, etc., which have to withstand at times considerable shock, electric steel provides the greatest safety in this direction, along with great wearing hardness.

Melting Methods.

The process of manufacturing arc-electric steel has been several times described, but the main points are given below, so as to form a basis for the development of one part of this Paper. The heat for melting, being obtained solely by conversion of electric energy, is, of course, free from sulphur, oxygen or other deleterious accompaniments. When considering the chemical actions and reactions, as compared with those taking place in an open-hearth furnace, this fact must be kept in mind, as, otherwise, one or two of the claims made in favour of electric melting would appear extravagant.

The raw material for arc-melting consists of steel turnings or whatever scrap is cheapest in the district. No pig-iron is necessary. Sufficient lime and iron ore or mill scale is added to the charge to form a slag and to oxidise the carbon, silicon, manganese and phosphorus present in the scrap. These elements pass out of the molten metal, partly into the slag and partly into the atmosphere. As soon as an analysis shows the bath is refined and a good heat is on the metal, the furnace is tilted backwards, and the first slag is poured off the charge over the back-door fore-plate.

An analysis of the bath, made just before slagging, will reveal the composition to approximate a pure iron, but containing some combined oxygen and most of the sulphur in the original scrap. Preparation is now made to add the necessary quantities of carbon, ferro-silicon and ferro-manganese to deoxidise the bath and to give the desired final composition. These are thrown on to the bare metal along with the final slag materials consisting, approximately, of 80 per cent. lime, 10 per cent. silica and 10 per cent. fluorspar. The steel is deoxidised under these conditions and the sulphur is automatically reduced to a trace.

The greater part of the deoxidation of the bath results from the addition of ferro-silicon and ferro-manganese, as in other steel-melting processes. The last trace of oxygen then left in combination is acted upon by the slag. The high-lime slag itself is first purged of all iron oxide by carbon additions. Under these conditions and at the temperature of the electric arc (about 3,600 deg. C.) calcium carbide is produced in the slag and attacks the iron oxide at the surface of the bath, returning iron to the bath, with or without carbon, according to circumstances. The reduction of some of the silica in the slag by carbon under the arcs also helps the deoxidation of the bath.

Influence of Calcium Reduction.

When deoxidation is completed, the silicon content of the steel tends to increase by reason of the continued reduction of silicon from the slag. Manganese oxide, rising from the bath into the slag, is also reduced by the carbon under the arcs, and the manganese sinks back into the steel, repeating this peripatetic procedure until the oxygen in the bath is below the value that manganese can attack. The calcium carbide formed in the slag is also instrumental in abstracting sulphur from the metal. Manganese sulphide is, probably, similarly decomposed by the calcium carbide.

It is not generally known that calcium is also reduced from the slag, and that as much as 0.5 per cent. of calcium can be found in some of the best electric-arc steels. During the latter stages of a heat the bath is rabbled to aid the uniform distribution of the constituents of the charge in the usual way. When samples of steel taken from the furnace and cast into test-moulds solidify quietly, the steel is free from combined oxygen, and is ready for tapping as soon as the chemical tests reveal the desired composition.

Electric steel for castings offers several pronounced advantages over other steels. When poured it is quieter in the mould and does not easily cause the sand to burn on. Quiet metal also gives much less trouble on contracting and seldom pulls. In steel foundries, the electric-arc furnace has found either a most happy home or the reverse.

Where an electric furnace has been a failure in a steel foundry, the onus must be attached to the individual installation. The fault may be with the furnace proper or with the general lay-out of the plant, but such defects must not be confused with the merits of electric steel as steel, any more than one would nowadays condemn steam as a motive power because a particular steam engine was badly designed.

When installing an electric furnace, the following observations should be kept in view:—(1) There must be plenty of room for the furnace operators all round the plant; (2) the furnace should not be in stagnant atmosphere; (3) the transformer chamber should be below furnace level when possible, so as to avoid the near presence to the furnace of the chamber walls, which tend to confine heat around the plant, and (4) when feasible, the furnace is best at an elevation above ground level with a stage erected as working platform for the melters. This arrangement reduces the cost of removing slag; facilitates better attention to the tilting gear and the underneath parts of the furnace; provides warm storage for refractories underneath the stage, and avoids excavating for a transformer chamber.

Useful Hints.

It is difficult for those not experienced in electric-furnace practice to know all the points to look after when considering an installation, and a few hints will be useful. Whether the plant is for making ingots or castings, a low cost of operation is essential. The items of cost, which vary on different plant, are: current consumption; electrode consumption; refractories and renewals.

Affecting the cost of production is the very great factor of continuous operation; in other words, yearly output of steel. The speed of an odd heat, or even a twenty-four hours' record, is no evidence whatever of the prime commercial factor of annual output. The weight of good steel manufactured per working hour is the index of the real speed of working and of total delays. Some delays may result from matters not arising on the furnace installation, and cannot be taken into full consideration; but delays on the installation itself, including those for repairs and renewals, are a valuable indication of the relative commercial value of different furnaces.

The engineering skill displayed in the design of each portion of the plant should be carefully looked into. Special regard should be paid to the strength, rigidity and safety of such vital parts as the electrode gear, tilting gear, transformers and switchgear.

As the necessary lowering and re-gripping of the electrodes in their holders is an operation which delays production, an important matter is to investigate the length of the free vertical travel provided for the furnace electrodes. The rate at which the electrodes are consumed greatly influences the periods between adjustments.

Electric-arc furnaces are serviceable for any output of steel required, from 10 tons per week upwards. A 5-ton furnace will yield 30 tons of steel per 24 hrs., or it may be worked during the day only should night work not be desired. A 10-ton furnace will yield up to 250 tons of steel per week. A 15-ton furnace will give 360 tons weekly. Stobie furnaces may be worked at reduced capacity should less steel be required at any time. Their efficiency is reduced only slightly by this procedure, when fitted with the economisers mentioned later.

Electrode Consumption.

The main consumption of the electrodes in ordinary electric-arc steel furnaces does not take place at the arcing end of the electrodes, but results from the surface burning of the carbon all over those parts of the electrodes which are inside the melting chamber and up to a point about 15 in. above the roof. On looking inside some designs of furnaces, the electrodes will be seen to be considerably tapered from where they enter the roof down to the arcing ends. Fully 75 per cent. of the heavy expenditure on electrodes is wasted through this defect. Various attempts to prevent this costly waste of electrodes have been previously made, such as enveloping the carbons with asbestos paste held in position by wire netting, coating the electrodes with non-burning paints, encircling the electrodes with steel collars held together by hinges or springs, surrounding the electrodes with water-cooled cylinders extending well inside the furnace. All such methods have met with failure because, by the first method, the asbestos perishes quickly inside the melting chamber, and is expensive to apply; in the second case the non-burning coatings all expand on heating, and fall away from the non-expanding carbon electrode; in the third case the collars do not protect red-hot electrodes from the air above the roof, nor are the collars efficient in keeping back the flames, and they have a very short life and are expensive in upkeep; in the fourth case, the internal jackets are most wasteful of heat, and, further, are dangerous inside the furnace and very ineffective.

* Lecture to the Halifax Section of the Foremen and Draughtsmen's Society, January 17, 1934.

It is thought by some not acquainted with electric-furnace practice that there is necessarily a reducing atmosphere inside all electric-arc furnaces. This is an utterly mistaken notion, which is proved by the ease with which the raw materials thrown into some furnaces oxidise even without the help of iron ore or other solid oxidant.

The Chimney Effect.

The cause of the oxidising atmosphere inside such furnaces is the crude method of feeding the electrodes into the melting chamber. The heated gases inside the furnace continuously pass up the clearances between the roof and the electrodes. The results are manifold; the gas effect causes the clearance to be rapidly increased by the flames burning away the electrodes to a tapered point, as previously explained; it wastes all the heat value of the gases and flames which are constantly pouring out of the furnace through the electrode holes; the escaping flames cause the electrode gear and current conductors over the roof to deteriorate rapidly; it causes undue heating of the electric terminals and necessitates their water cooling; and it lengthens the duration of the charge in proportion to the heat lost through the roof holes. The considerable effect of all this on the cost of producing the steel, quite apart from some loss therefrom of control over the operation of the furnace, will be readily apparent.

Observation showed that at about 2 ft. above the roof, in most furnaces, the electrodes, even when raised for charging, are seldom at a temperature at which they can burn; therefore, that is the only point at which a permanently good seal for the roof can be made round the electrodes. If an electrode is closed hermetically from the roof up to that point, the burning away of the electrode and the escaping of the heated gases from the furnace is prevented.

In practice, the Stobie economiser, which overcomes these defects, consists of a light metal cylinder, measuring a few inches larger in diameter than the electrode, and about 2 ft. in length, fixed on the roof round each electrode. The top end of the cylinder is covered with an annular sealing plate, which prevents the passage of the flames, the electrode passing through a neatly-fitting hole in the centre of the seal.

The effects of this most important improvement in electric-arc furnaces are vastly beyond what might be expected from so simple a device.

Benefits Derived from Economisers.

The thorough sealing-up of the furnace roof gives the following revolutionary improvements:

(1) No cold air is drawn into the furnace.

(2) No flames or highly-heated air burn away the electrodes above the roof.

(3) A really reduced, carbon-depositing (when desired) atmosphere is maintained within the melting chamber.

(4) The oxygen-free atmosphere of the furnace prevents the burning of the electrodes inside the furnace, except at the arcing ends, and, therefore, electrodes remain parallel instead of tapering.

(5) The electrodes can be of smaller diameter for a given current supply. This, in addition to cutting down electrode costs, permits a reduction in the size of the electrode holes in the roof, thereby adding great strength to the roof.

(6) The life of the roof is considerably increased, because the thick carbonaceous atmosphere inside the furnace acts as an opaque curtain through which the intense heat of the arcs cannot be radiated upwards to the roof.

(7) The flames inside the furnace, not being able to pass out at the electrode holes, travel all over and among the charge and heat this up rapidly and very economically.

(8) The electrode gear over the furnace does not become hot. Any adjustments required in the electrode gear over the roof can, therefore, be done in ease by the furnace hands while the furnace is at top heat. In the same way, the absence of the great columns of flames, which continuously rise through the electrode holes of some furnaces, and which radiate intense heat all around, renders the Stobie furnaces much cooler to work.

(9) In consequence of the exclusion of free air from the furnace, and the absolute control which this permits over oxidation, scrap steels containing oxidisable elements such as chromium, tungsten, manganese and even vanadium, can be melted with almost inappreciable loss of the special elements from the bath. In furnaces not provided with Stobie economisers the major portion of such elements is first oxidised out of the charge into the slag, and has then to be skilfully recovered, if possible, at great expense of time and current.

(10) The absence of heat from the electrode gear enables the electrode-current terminals to be made of copper contacts, built up of standard-shape copper bars, instead of the usual intricate, heavy, water-cooled bronze castings.

This economiser is a feature which has done more than any other part of an arc furnace to reduce the cost of manufacturing electric steel.

High-Frequency Furnaces.

The electric melting of steel, or other metal, by high-frequency induction brings the exactitude of scientific-laboratory methods to the commercial melting of such materials. In the Witton high-frequency furnace (Stobie patents) metals can be melted with such precision that the resultant melt is practically identical in composition with the materials charged into the furnace, and the control of temperature is such that it could be to within a degree of two Centigrade if this were necessary and measurable.

The property of alternating currents, which makes the iron parts of an electric motor or transformer warm in use, is taken advantage of and emphasised in the design of a high-frequency furnace. In a motor or transformer the iron parts are constructed to absorb the least possible electrical energy, as the latter represents loss of efficiency. In the high-frequency furnace the reverse is the case, and the charge, of steel or other metal, is in a position and state which will absorb the utmost electric energy and produce the greatest heat. Each separate alternation of the current sent to the high-frequency furnace induces a given quantity of heat in the charge; for which reason the periodicity of the current alternations is increased much beyond the normal 50 cycles per sec. used for ordinary electric supply. However, other factors also come into play when frequency is increased, and, as a result, there is, for highest efficiency, a value of it for each furnace beyond which it is not advisable to go.

A simple description of the principle of the Witton furnace is that it consists of a coil of water-cooled copper tubing around a crucible containing the charge, and alternating current at about 500 cycles per sec. is sent through the copper coil. The alternating magnetic field produced in and around the coil by the alternating current is not allowed to stray, as in older high-frequency furnaces, but is held captive by an ingenious ferro-magnetic device which disgorges it into precisely those parts of the charge which will convert it into the greatest heat.

As the heat is generated within the charge itself, the efficiency of the furnace is very high. Actually it is, by far, the highest of any known melting system. Steel has been melted in a 6-cwt. Witton furnace with as low a current consumption as 485 units per ton. This furnace, like the arc furnace, is regulated by automatic means, the melter simply setting a hand-wheel to fix the power required on the furnace.

Metal Movements.

An interesting phenomenon is observable in the high-frequency furnace when the charge is molten. The liquid mass is slightly higher at the centre of its top surface than elsewhere, and flows symmetrically down to the periphery of the surface, where it forms a convex meniscus. The metal travels constantly in this manner, which causes an automatic mixing of all the charge and ensures perfect homogeneity.

This movement is due to the current induced in the charge being in opposite direction to that in the coil round the crucible. As opposite currents in near conductors cause the conductors to repel each other, the liquid steel, being one such conductor, yields and is pushed inwards by the coil, the other conductor, which abuts against immovable supports. The particular outline assumed by the flowing liquid is due to the hydrostatic conditions in the crucible in combination with this inward radial pressure.

The force of the movement can be too rapid if allowed to have free play, and the Witton furnace is specially constructed so that the movement is sufficient for mixing the charge without causing the heavy crucible wear that would otherwise be present.

It has, hitherto, been levelled against the high-frequency that, though excellent for melting, it was not suitable for refining metals. A recent striking invention in design provides thick sloping banks where the refining slag washes the lining, just as in open-hearth or arc furnaces. It can, in consequence, be predicted that these furnaces will vastly increase the field of high-frequency melting.

Development in Wrought-Iron Manufacture.

As reported briefly in our last issue, an interesting industrial event took place recently at the works of the Midland Iron Company, Limited, Rotherham, when Mr. Geo. Baker, O.B.E., President of the Rotherham Chamber of Commerce, set in motion the 500-h.p. motor to drive the forge mill. The 8-in., 9-in., 10-in. and 16-in. mills were electrified a few years ago, and this completes the electrification of the rolling mills by which the works have attained a unique position in the wrought-iron industry.

After switching on the power, Mr. Baker said that he was glad to see the developments taking place and that the company had taken the wise course of putting their works in order. Trade was better, and if the steel, iron and coal trades begin to move, other trades will move with them. Alderman A. R. Habershon, J.P., chairman of the Rotherham Electricity Committee, said he was glad to see the signs of trade improvement, and that the old works, which had been in existence for 90 years, had been brought completely up to date. Since the company was reorganised in 1931, no efforts have been spared to put the works in a position to supply wrought iron made under the most favourable conditions and the output to-day is 100 per cent. more than it was twelve months ago.

Amongst the company were Mr. A. J. Ward, J.P., director of the Midland Iron Company and assistant managing director of Thos. W. Ward, Limited; Mr. W. H. Duffett, M.I.E.E., M.I.Mech.E., engineer and manager of the Rotherham Electricity Department; Mr. J. T. Haynes, A.M.I.C.E., engineer and manager of the Rotherham Gas Department; Mr. A. Corker, managing director of the Midland Iron Company; and Mr. W. A. Ward, assistant managing director of Thos. W. Ward, Limited. At the luncheon, Mr. A. J. Ward, who presided in the absence of the chairman, Mr. Joseph Ward, congratulated Mr. A. Corker on attaining his jubilee with the firm.

Messrs. Cammell Laird & Company, Limited, Birkenhead, have received orders from the Booth Steamship Company to build two cargo steamers of about 5,000 tons each.

Education of Foundrymen.

APPRENTICESHIP RECRUITMENT AND TRAINING PROBLEMS.

Suggested Solutions from Yorkshire Foundrymen.

Under the auspices of the West Riding of Yorkshire Branch of the Institute of British Foundrymen, MR. H. A. MACCOLL, B.Sc., Lecturer in Metallurgy at Bradford Technical College, addressed the members on the subject of "The Training of Foundrymen with respect to the Future Welfare of the Industry," which was printed in our issue of January 11, 1934.

A Dearth of Recruits.

MR. A. S. WORCESTER said he felt there was not much wrong with the facilities that had been granted to the foundry industry by the educational authorities, and he was confident that if the industry wanted still further facilities they would probably be forthcoming provided the industry itself was ready to take advantage of them. The problem was not one of getting good courses of tuition so much as finding the young men to take them up. Personally, he felt there was a very great need for intensive effort in the craft to persuade the lads of the desirability of joining the available classes and persuading their seniors to afford them any necessary facilities to do so. In Huddersfield, as distinct from a good many areas, they had had quite gratifying success in these directions. It was strange that in great centres like Leeds and Bradford the response was so astonishingly little. Three years ago at Huddersfield something like 90 per cent. of the eligible youths were secured. Appreciation of the course was such that at the end of the year there were something like 80 per cent. of them studying, and there was still a very good class to-day. It behoved the Institute, the recognised body for improving the status of the foundryman, to do all that reasonably lay in its power to meet, at its own end, the generous helpfulness of the public educational authorities at the teaching end, and suggested that somebody should set about definitely on a planned effort for Leeds, Bradford, Halifax and, if necessary, other centres. One factor which Mr. Worcester said he would like to emphasise, particularly in relation to such courses as the National Certificate, was that although admittedly training for executive positions was desirable, the primary business of the Institute and those associated with it was to prepare a good general level of educated craftsmen rather than endeavour to create from average human material a limited number of supermen. The City and Guilds course, to his mind, was the course in which they as an Institute had reason to be most concerned, with a view to raising the general mental level of the industry as a whole.

The National Certificate.

MR. MACCOLL, replying, said that, as a member of the Institute of British Foundrymen, he did not feel they had done very much good to themselves as an Institute by asking another institute to modify their examination to suit the requirements of the young foundry student. He really felt it would have been better for the Institute to have solved the problem themselves. Personally, he strongly favoured the development of the day apprentice course, and hoped more foundry proprietors would encourage their youths by offering them facilities. There might be objection on the plea that only the larger firms could afford to grant such facilities, but he would suggest, if it paid the larger foundries to do that, why should it not also pay the smaller firms to have their lads benefited and improved in their work and knowledge by similar means? The attendance of the lads rested very largely with the employers. It was merely a matter of making it clear to the youths that promotion and advancement were likely to depend on success at the classes.

The Employers' Position.

MR. GEO. HALL (Shipley) contrasted the present difficulty of getting the youths to come into the foundry industry with the ease of 30 years ago, when they could hardly keep them out. The rush of lads at that time, one recalled, was such that the trade unions had to make rules to put a limit on the number of lads proportionate to men. So far as concerned the position of the lads who were available for classes, it seemed to him that the responsibility lay definitely with the employers rather than with the foundry managers and foremen.

Craft and National Certificates.

MR. F. K. NEATH (Keighley) said a difficulty was that it had become so complex an industry now that they had all manner of foundries from the modern light castings, mass production, establishment where it would seem there was comparatively little need for the really skilled craftsman, to the average jobbing foundry, with its heavier casting and individual work calling definitely for that very highly-skilled craftsmanship which the industry seemed in danger of losing. When one recalled that the foundry industry of this country to-day had a financial turnover of some 30 or 40 million sterling per year, it became rather staggering to realise that they had not tackled this problem of the future foundryman more seriously. Mr. MacColl had criticised quite frankly those in charge of foundries for lack of encouragement of the educational scheme, but there were, of course, distinct exceptions to whom every credit was due for the help they had given and were given. The schemes put forward with the blessing of the Institute deserved every encouragement, because they were aimed solely at producing a more skilled workman and craftsman. That, surely, must be to the benefit of the whole industry, employing and employed alike.

Mr. MacColl had asked whether there was any effective linking-up between the Craft Certificate scheme and the National Certificate scheme. Mr. Neath was glad to say he knew personally of two students who had passed from the one to the other, feeling that, if they had both, they would be better equipped for their job. Youths who had that spirit of enterprise were the kind likely to become the executive authorities of the future, but, of course, the Institute was not out to create so big a crowd of super-men that there would not be positions enough for them. It would welcome the super-men, but it aimed mainly at raising the educational level of the whole craft. Hitherto, Mr. Neath thought, there had been a tendency for too many technical colleges to set out to prepare youths for the National Certificate, but they found they either had not the necessary facilities or could not get the necessary boys. Mr. Neath had heard it said—and he believed it was likely to prove so—that this National Certificate training would probably "boil down" to perhaps a couple of centres for the country, leaving the remainder to concentrate more on the Craft Certificate. In France, he believed, the equivalent to the National Certificate course had been reduced to one centre only. As Mr. MacColl had criticised the foundry industry quite candidly, he would no doubt forgive a little equally candid retaliation to the effect that a good many technical colleges—Bradford, admittedly, was an exception—did not provide the right type of instructor; they had an instructor who may be excellent on the teaching side, but who entirely lacked the practical personal experience in a foundry which would make the teaching so much more effective.

Dearth of Proper Instructors.

MR. MACCOLL, in reply, said Mr. Neath's latter comment had "hit the nail on the head," though in defence of the colleges it must be pointed out that there was a good deal of difficulty in getting the type of instructor who had had practical foundry experience as well as being in a position of academic attainment and teaching ability to meet the combined need. It was not common to find the practical foundryman thrown into teaching unless by force of personal circumstances. Personally, as the ideal method of tuition he would not advocate so much practical foundry work in the colleges as by a capable practical guide in the foundry itself if the man and opportunity were available. An exception to that method would be in the case of certain phases of work which were outside the range of the individual foundry's usual operations, and would necessitate special expenditure of money for teaching purposes, which could hardly be considered justified when it could be done at a college for the general benefit. As to the National Certificate, Mr. MacColl did not think the course itself was really attractive to the average boy, though it might attract some whose mind was looking far ahead to executive positions. The average boy going in for a tuitional course in foundry work had a practical mind which wanted to get on to some practical foundry work at once and not have to wade through a five-years' theoretical course first. As things stood at present, it was an actual possibility for a boy to take the ordinary National Certificate in reference to the foundry industry and have done no actual foundry work in his course. That seemed to him (Mr. MacColl) distinctly anomalous.

A MEMBER, speaking as a former student, said if a word in defence of the boys might be permitted in this discussion, he might say he was himself one of thirteen young men who had joined a class, but they gave it up because they were unable to keep up to the pace of the best and no effort was made by the teacher to help them.

MR. S. W. WISE (Bradford), hon. secretary, said this question of encouraging technical education must be worked from the foundry outwards; they of the industry itself had to work up an atmosphere from the foundry itself that would instil among the younger men coming on in the craft a desire for more knowledge by way of the excellent educational facilities offered them. Huddersfield undoubtedly was very fortunate in having awakened the interest of the employers to such an extent that it had a technical advisory committee of employers. Foundry conditions and labour were such that it was by no means so easy a matter for the foundry apprentice to go to classes as it was for some others, but everything possible should certainly be done to facilitate such attendance.

MR. MACCOLL said that the spread of technical education among young foundrymen was sometimes handicapped by a certain old type of foundryman who had no appreciation of technical teaching; the man who, being a practical man whose knowledge, such as he had, was gained entirely from years of labour in the works, had a supreme contempt for anything in the way of theory teaching, and who had, in fact, been known in not a few cases to deliberately talk youths out of joining a class. Such a man was really doing a serious disservice to his industry.

Influence of Modern Routine Methods.

MR. J. J. WATSON (Huddersfield) said another handicap in modern foundry work was that many young men had to adhere solely to one phase of daily work. They had to go through the same restricted routine and had little chance of experience in other directions. Particularly was this so in the foundry working on mass-production methods. If the lads could get even so little as

a half-day per week in some other department of work it would widen their experience of the practical side and be a great help in any studies which they undertook. Mr. Watson said great credit was due to Mr. Worcester and Mr. Wise for the big personal part they had played in the establishment of the successful courses at Huddersfield three or four years ago.

Mr. MacColl said he entirely agreed as to the desirability of lads having the benefit of as much variety in daily work as was possible. On the other hand, employers were not solely to blame. Mr. MacColl recalled the case of a foreman who openly boasted of the number of years he had had certain men on certain jobs. This foreman considered that was an achievement, little realising that it meant the men were in a hopeless rut and practically helpless in regard to getting another job elsewhere if the need should arise.

Commercial Considerations.

Mr. J. Fearnsides (Keighley) said it had to be remembered that employers had to face the stress of intensive competition in trade. To offer special facilities in the foundry for training the young men must cost money, and many are not inclined to devote money to the training of a youth who, as soon as he became sufficiently qualified to be able to repay that expenditure by better work, may seek and obtain a job with a rival firm.

Mr. MacColl agreed that that was an aspect of the situation which had to be recognised. The only hope of minimising that difficulty seemed to be concerted action among the employers themselves. In that event what an employer might lose in one man he would be likely to gain in another.

Mr. S. Carter (Huddersfield) said the average foundry apprentice of to-day was certainly the equal of his forebears in knowledge and skill proportionate to age. Furthermore, he did not really believe there was quite that dearth of youths for the industry which a good many foundrymen seemed to consider so serious to-day.

Defect in Educational System.

Mr. G. Copeman (Leeds) said he felt the educational system itself was largely at fault in maintaining the difficulty of getting students among young foundrymen. The courses, he felt, were too academical for the average foundry youth. A lad of 14 was expected to assimilate a quantity of theoretical knowledge which it would take a grown man all his time to learn. There was also the difficulty of school-leaving age and the increasing tendency for professions of every kind to absorb the boys of secondary-school education. Probably if the general school-leaving age were raised to 16 years a type of lad of better general education might then be available for foundry work, and could more readily take up the technical courses.

Mr. H. Farrar (Shipley) felt masters in the past had been led away too much in the direction of specialising boys in certain phases of work. That might be responsible for a good deal of the dearth of foundry apprentices.

The Chairman (Mr. Welford), closing the discussion, said he entirely supported the plea in favour of day courses; it was hardly fair to expect the young apprentice to go to a series of night classes after heavy days of work in the foundry, and it was to be hoped that every possible effort would be made by responsible authorities in charge of foundries to make it possible for greater use of the day-time courses available. The Degree in Foundry Science, of course, was obviously intended for what had been termed the "super-man"; the man who, in simpler language, may be regarded as the future foundry manager or proprietor.

Hearty thanks were awarded Mr. MacColl for his address, on the motion of Mr. H. Roberts (Leeds), seconded by Mr. W. Parker (Past-President), of Halifax.

West Yorkshire Branch Dinner.

The Third Annual Dinner of the West Riding of Yorkshire Branch of the Institute of British Foundrymen took place on January 13 at the Great Northern Victoria Hotel, Bradford, when the Branch-President (Mr. R. D. Welford, of Bradford) presided over an excellent gathering of members, with their ladies and visitors.

The chief guest was Mr. C. E. Williams, of Cardiff, President of the Institute. Mr. H. Richardson, Principal of the Bradford Technical College, who was unable to be present, was represented by Dr. H. W. Swift, Head of the Department of Engineering.

Following the loyal toast, Mr. Welford proposed the toast of "The Visitors." Welcoming the President (Mr. Williams), he said the Institute had been very fortunate in its choice of Presidents and had every reason to be grateful to those who aspired to that high office. Mr. Williams, indeed, was one who had the cause of foundry technical education very much at heart. The Branch were sorry Mr. H. Richardson, Principal of the Bradford Technical College, had not been able to visit them that evening, because they wished to pay their tribute to the fine support given the movement by that College. They were, however, glad to have with them Dr. H. W. Swift, Head of the Engineering Department of the College, and one who had on a good many occasions demonstrated his interest in foundry trade education in very practical manner, both by the facilities offered at the College and by his own presence and contributions at some of their branch meetings.

The President (Mr. Williams), in responding, expressed thanks to the Branch for its hospitality and for its hearty Yorkshire welcome. This was his first visit to Bradford, but he knew it was a city with a great industrial reputation and one in which the foundry trade took no small part. He had been rather particularly struck by the historical fact that Bradford was the first place in the country to erect a big hall devoted definitely to the cause of temperance. The fact had impressed itself on his mind because, whilst Bradford expressed itself on liquor temperance in that way as far back, he believed, as 1837, the West Yorkshire Branch of the Institute of British Foundrymen had throughout its history expressed itself as equally temperate in its demands on the Institute and in its expenses. The Branch was not the biggest, but it was undoubtedly amongst the most active, and in the matter of subscriptions it was in the proud position of having the lowest record of arrears.

The Real Motto.

Mr. Williams, turning to his chain of office, referred to the motto, "Science hand in hand with Labour." He said they could hardly conceive of a finer motto than that for a body representing a great engineering industry, but, curiously enough, since arriving in Bradford, a lady who examined his chain through a magnifying glass had drawn his attention to the fact that the motto went into more detail than perhaps most members of the Institute had realised. The full and detailed motto was, "Science hand in hand with the dignity of skilled labour." That expressed perhaps even more closely the meaning of the relationship between the Institute and technical training for foundrymen.

Looking back over the year 1933, the President said he felt it was a year in which, despite the effort to emerge from heavy depression, the Institute had carried out the meaning of its motto with dignity and sincerity. Year in and year out the Institute was working with the interests of its members and the foundry industry at heart. It was responsible for a great deal of research work and for much which went to the betterment of conditions for foundrymen of all grades. During the past year, perhaps the outstanding factors had been the excellent technical section arranged by the various committees of the Institute at the Foundry Trades Exhibition in London; the issue of an important booklet on "Typical Microstructures of Cast Iron"; and latterly the efforts which were being made, in conjunction with influential personalities in the engineering educational world, to bring about the establishment of a chair of foundry metallurgy at the University of Sheffield. This was in no sense an expression of depreciation of the splendid work already being done by the various Technical Colleges, but to secure facilities of a University character would, of course, help greatly in raising the status of the whole craft, as well as offer increased opportunities for securing the highest possible degrees of qualification for those who, for instance, contemplated definitely an executive position in the industry. The past year had been an anxious one for all in the foundry industry, as it had for most others; but as it drew towards a close, there was a definitely optimistic feeling throughout the country and indications that the turn to better conditions had been made.

Dr. H. W. Swift, proposing the toast of "The West Riding Branch," said, as representing the Bradford Technical College, that that institution was proud to be associated with the Institute of British Foundrymen and to be able, within its limits and resources, to help in the instruction of young foundrymen. In the toast he would like to couple the name of Mr. Wise, the indefatigable hon. secretary of the West Riding Branch. It had been truly said that a voluntary body such as theirs must rise or fall largely according to the efficiency, energy and tact of its officers, backed, of course, by a loyal membership; but particularly did that apply to the hon. secretary, and in Mr. Wise the West Yorkshire Branch were extremely fortunate. He hoped they would be able to retain Mr. Wise in that office for many years to come.

The toast was drunk with musical honours.

Mr. Wise, responding, said his duty was to thank them for a very happy toast to the Branch, but he could not resist expressing personal thanks for the nice things said about himself and what little service he was able to render. Perhaps it was a testimony to the serious-minded character of the members of the West Yorkshire Branch, concluded Mr. Wise, that it seemed so much easier to get large attendances at their technical meetings and lectures than it did to get a considerable section of the members to come and enjoy themselves at the annual dinner. He hoped they would realise that life was not all work, and that the lighter side and the social side had a very real value even in a business organisation. So far as concerned the work of the Branch, he wanted to say the prosperity of the West Yorkshire Branch did not by any means arise out of the secretary alone, but by the help and encouragement given to the Branch officers and himself by the general members.

The speeches during the evening were interspersed delightfully by vocal, orchestral and humorous items by a concert party, supplemented —to the huge delight of all present—by a home-made parody on foundry life, to the tune of "The Village Blacksmith," written and sung by Mr. A. S. Worcester, the Immediate Past-President.

Iron and Steel Reorganisation.

The London Iron and Steel Exchange held its annual dinner at Claridges on Tuesday night. Sir William Firth presided, and urged the need of Government control to rectify the uneconomic position of the industry in the export market. Mr. Chas. Mitchell who followed him almost entirely dissented from his views. Mr. Colville, secretary of the Department of Overseas Trade, was the principal guest. Amongst personalities present well known in the foundry industry were Sir William Larke, Mr. Ben Walmsely, Mr. P. G. Donald, Mr. Chas. Lloyd, Mr. W. R. Long, Mr. V. C. Faulkner, and Mr. H. W. Lockwood.

The Institute of British Foundrymen.

BIRMINGHAM BRANCH DINNER.

Mr. E. J. Fox on the Competition of Weldings.

On the occasion of their annual dinner, held at the Imperial Hotel, Birmingham, on January 20, members of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen had the pleasure of entertaining the President of the Institute (Mr. C. E. Williams), members of the General Council, together with the General Secretary (Mr. T. Makemson), Mr. E. J. Fox, Mr. C. E. Lloyd, and Mr. V. Delport (American Foundrymen's Association). The large company, which included many ladies, was presided over by Mr. E. J. Lewis (Branch-President). After dinner there was dancing and whist.

The toast of the Institute was proposed by Mr. E. J. Fox, managing director of Stanton Ironworks. Speaking as a producer of pig-iron to consumers of that commodity, he claimed that producers had not altogether failed in their task, in that they had made available for consumption pig-iron at a cost lower than that obtaining in any country of the world with the exception of India. In spite of the low price the consuming industries of this country had failed, owing to problems and difficulties of their own, adequately to absorb the output. Great credit was due to the Institute for the important part it had taken during recent years in advancing the progress of the foundry trade. Thanks to research, considerable knowledge had been gained, particularly from a metallurgical point of view; and, judging by the number of Papers presented by members and the interesting discussions which followed, probably no other scientific institution in the country showed greater enthusiasm and zest in its work. Since the early days of civilisation, ironfounding had been the foundation of mechanical engineering and to-day played an important part in industry. The necessity of continuing research is, therefore, evident. In many branches of engineering iron castings were being superseded by what is called fabricated steel. He hoped, in the interests of the foundry trade as well as of the pig-iron manufacturers, that efforts would be made, by an improvement in quality and reduction in price, to meet this new competitor. Foundrymen had no difficulty to-day in obtaining a strength of 20 tons per sq. in., and this, combined with more attention paid to the chemical composition of the castings for meeting special conditions, should help to retard the progress of fabricated materials. Fabricated steel necessitated a complete change in the personnel of the designing staff; in other words, it introduced a completely new technique, and while it might prove of advantage when carried out on a large scale, it was doubtful, to his mind, whether it could be adopted with advantage in the smaller establishments. Where the line would ultimately be drawn must to no small extent depend upon the enterprise of the foundry trade in improving production methods.

Much had been said in recent years about the mechanisation of foundries. We had to admit that, compared with certain other countries—notably America, Germany and France—we had been less enterprising in this direction. There was, of course, a reason for this. In England we had had a plentiful supply of highly-skilled moulders, whereas in some countries abroad they had been compelled, due to scarcity of this class of labour, to introduce machine moulding to compensate for the lack of suitable labour. Owing to keen industrial competition between nations, we had had to pay more attention to this subject with a view to reducing costs of production. It might be argued that the particular type of casting produced did not lend itself to mass production, but here again it was probable that partial mechanisation, or a reconstruction for introducing plant for the mechanical handling of materials, would effect a saving in labour charges which would justify the capital outlay.

He wished the Institute every success. He was fully cognisant of the excellent work that had been done and of the most important work in hand. To those, and there were many, who lived on the production of pig-iron, obviously the foundry trade was of primary importance, which was an additional reason for the Institute having his good wishes.

A Balanced Budget.

The President of the Institute, Mr. C. E. Williams, in responding, wished everyone present a happy and prosperous New Year, expressing a hope that the prosperity would not be confined to the foundry industry or to this country, but would extend throughout the world. Thanking those who had assisted in making various activities of the Institute a success, he included the members contributing Papers. He also thanked The Foundry Trade Journal for its "invaluable and sustained help." The educational work of the Institute, he said, had been carried on whole-heartedly during the year. As an Institute, they had passed through a very prolonged deep and serious depression, and he hoped that the closing of the financial year would leave them without loss. They thought they would just about balance their budget. They might feel justly proud that so few members had been forced to relinquish their membership through the hard times. If he was right in using the past tense with regard to the hard times, and if it was true that a slow and quiet trade recovery was in progress, he looked forward to the lapsed members being able to rejoin. In that event he could assure them of a double and very hearty welcome.

He regarded it as an honour to be asked to respond to the toast of the Institute. The honour was all the greater because it was in Birmingham that, in 1904, the Institute was started. Long might the Institue flourish.

How to make Malleable Iron!

Mr. C. E. Lloyd, who submitted the toast of "The Birmingham, Coventry and West Midlands Branch," said that, as a forge master, he had a bone to pick with some of the members. "We used to make chains out of good, honest, forged material," he continued, "and some of you make them out of cast steel now. Then there is something that you call malleable iron. I know a bit about that. I believe you are something like doctors in some of your prescriptions. I fancy that I should not be far wrong if I were to say that for certain specifications you take a couple of old firebars and a bucket that leaks, perhaps two or three chunks of billiards chalk to make a bit of flux, a tube of tooth-paste and a few other things, melt it all down and then stew it in what old boots you can spare. You call that malleable iron and sell it in competition with a good forging, and what is more you get away with it. I am not going to blame you. I will take my hat off to you. It seems to me that you are absolutely cast iron in your determination to make a profit somehow."

Mr. Lloyd added that he had the greatest respect for the admirable practical mind of the Institute. They did not go into any unnecessary elaborations. They got down to their proper work without waste of money or words.

A Key Industry.

The Branch-President, speaking in acknowledgment, said they were engaged in a trade which went back to time immemorial and with a great tradition. He was confirmed in that statement by some of the fine work being done to-day. "We are a key industry of industries," Mr. Lewis added. "Without us civilisation would cease; human progress would stop. Without us machine shops would not exist, for the simple reason that they would have no machines to operate." All connected with the foundry trade ought to be proud of it.

It had been recalled that it was in Birmingham that the Institute was formed, and they were proud that there were still members of the Branch, as well as, he believed, of some other Branches—some in the room that night—who started the Institute. They owed much to these gentlemen, who had the foresight to form an Institute of that description. It was their foresight, very largely, that had made the industry what it was to-day, that had lifted it out of its former Cinderella position and made it the leading lady in the engineering world.

The Philadelphia Congress.

The health of the guests was drunk on the proposition of Mr. D. H. Wood, and Mr. V. Delport, in reply, referred to the great part played by the Birmingham Branch in international relations with other foundry associations. It was in 1922, at the time of the convention and exhibition in Birmingham in June of that year, that the idea of international congresses on a large scale was originated. At all the congresses since held not only had the Institute of British Foundrymen, but the Birmingham Branch, been very largely represented. He invited them to attend the 5th International Foundrymen's Congress to be held in Philadelphia in October of this year. The invitation, he explained, was addressed not only to the gentlemen but to the ladies. At the moment he had no details of the programme, but he could say that the visitors would spend the best part of a week in Philadelphia, during which time they could attend the technical sessions, where a number of Papers would be presented, and also visit the international exhibition, where they would be able to investigate and study the latest developments in foundry plant and equipment that had taken place in the United States. They were all aware that the United States had unfortunately experienced, and was still experiencing, a very intense crisis. He thought it would be of considerable interest to those who made the journey to see how that nation was trying to solve its problems. Following the week of the exhibition and technical sessions there would be visits to works and foundries, with an opportunity to see the application of the principles and methods of solving current problems. Mr. Delport commented on the friendships formed at the congresses between members of the Institute and of the American Foundrymen's Association, and said that in the coming congress there would be the opportunity to renew past friendships and start new friendships. He hoped that a large party would go to America. A group would be organised and it would be possible to make the journey at the least expense and trouble. Circulars would be issued at an early date to all members of the Institute, and he asked all who had the least intention of attending the congress in the United States to return the reply form. In so doing they would not be committing themselves to anything at all, but they would be assured of receiving details of the programme as soon as they were available.

Owing to the unforeseen number of members and friends who attended the dinner it was found necessary to divide the party and arrange for dinner to be served in an adjoining room. This would have been unsatisfactory except that by arrangement with Henry Riley & Sons, Limited, of Birmingham, it was found possible to relay the after-dinner speeches to the second room. This innovation worked very well, the speeches coming over with remarkable clarity and volume.

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Institute of British Foundrymen.

ELECTION OF NEW MEMBERS.

At a General Council meeting of the Institute of British Foundrymen, held at the Imperial Hotel, Temple Street, Birmingham, on Saturday, January 20, 1934, the following were elected to various grades of membership.

As Members.

J. F. Stanier, technical representative, Renishaw Iron Company, Limited, near Sheffield.

J. N. Deas, managing director, Thos. Allan & Sons, Limited, Bonlea Foundry, Thornaby-on-Tees.

E. K. Hancock, representative, J. C. Abbott & Company, Limited, Birmingham.

W. D. Joslin, director, Borough Engineering Works, Limited, Luton, Beds.

E. P. Barlow, representative salesman, T. W. Ward, Limited, Sheffield.

A. L. Brown, works manager, Lion Foundry, Kirkintilloch.

R. Coulthurst, chief draughtsman, H. J. & A. Coulthurst, Limited, Darwen.

D. McC. Hay, chemical salesman, I.C.I., Limited, Glasgow.

R. Mitchell, engineering works manager, J. F. Low & Company, Montifieth.

E. F. G. Parramore, metallurgist, F. Parramore & Sons, Sheffield.

Thos. Bunn, works manager, Hill Top Foundry Company.

S. Hadfield, representative salesman, T. W. Ward, Limited, Sheffield.

J. O'Neill, blacking manufacturer, Scottish Founders Blacking Company.

C. Roberts, representative, Fordath Engineering Company, West Bromwich.

J. W. P. Smith, director, Foundry Services, Limited, Birmingham.

E. Weiss, director, Foundry Services, Limited.

C. Wright, master patternmaker, Wright & Platt, Limited, Birmingham.

As Associate Members.

E. L. Bromige, moulder, Specialloids, Limited, North Finchley, London, N.12.

H. W. Merritt, works chemist, Davis Gas Stove Company, Limited, Diamond Foundry, Luton.

C. Clarke, foundry foreman, C. Wicksteed, Limited, Kettering.

D. C. Hague, draughtsman.

H. Lowe, foreman ironmoulder, L.M.S. Works, St. Rollox, Glasgow.

R. Addenbrooke, assistant foundry manager, Thos. Holcroft & Sons, Limited, Wolverhampton.

J. Claydon, chemist, Parkinson Stove Company, Limited.

T. A. Glynn, patternmaker.

E. J. R. Mitchell, metallurgist, Mirrlees, Watson Company, Limited, Glasgow.

T. Shuttelton, engineer, G. & J. Weir, Limited, Cathcart.

As Associates.

J. Bedford, patternmaker, J. N. Chadwick, Limited, Bolton.

A. Dunlop, laboratory assistant, Glenfield & Kennedy, Limited.

F. B. Ollerenshaw, assistant foundry foreman, Davy Bros., Sheffield.

N. Reynolds, moulder, Howard & Bulloughs, Limited.

Ed. Outhard, moulder, Dorman, Long & Company, Limited, Middlesbrough.

The Duncan Stewart-Demag Corporation, Limited, 54, Victoria Street, London, S.W.1, have been entrusted by the United Steel Companies, Limited, with an order for converters and auxiliaries for the extensions to their acid-Bessemer plant at Workington.

Another Gigantic Sheffield Casting.

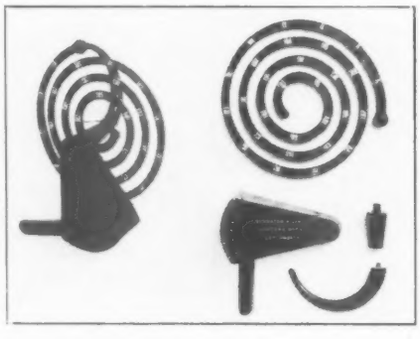
From time to time we have recorded pictorially the huge ingot-mould castings in course of transit from the works of the Brightside Foundry & Engineering Company, of Sheffield. The one illustrated below shows a casting weighing 120 tons, and is the largest ever made in Great Britain. It is shown in course of transport by

An Exceptionally-Large Ingot-Mould Casting being Transported.

the largest motor-transport wagon in the world to the English Steel Corporation, where it will be used for receiving metal destined to become hollow forgings. The forgings will form part of the plant to be used by Imperial Chemical Industries for reducing coal to oil.

Fluidity Tests.

When Mr. A. C. Furmston, of Messrs. Furmston & Lawlor, patternmakers, of Bird's Hill, Letchworth, Herts, showed to us the picture which we reproduce below, we were immediately impressed with the necessity for the standardisation of such patterns. The one he has created is a replica of the one which has been standardised by the I.B.F. Committee. Mr. Furmston has made a proper master pattern from which he casts replicas for use within the foundry industry. It gives a spiral 60 in. long and is



A Standardised Life-Test Mould.

graduated into 2-in. lengths. Sales have already been made to foundries, the staff of which form part of the personnel of the Technical Committee of the Institute of British Foundrymen, and to the Universities, including Cambridge and Sheffield. If any member of the foundry industry wishes for modifications, it is desirable that he expresses his notions immediately, as it is essential for the sake of scientific comparisons of results attained throughout in-

(*Concluded in next column.*)

Book Review.

Symposium on Cast Iron. Held at a joint meeting of the American Foundrymen's Association and the American Society for Testing Materials. Published jointly by these bodies from 222, West Adams Street, Chicago, Ill., and 260, St. Broad Street, Philadelphia, Pa. Price one dollar.

We are not particularly enamoured of the title of this book. A symposium was originally a drinking party. Now it is defined as a philosophical discussion or set of articles on one subject from various authors. The recently-published symposium on steel castings did come within the definition, but we suggest that this particular publication should be called "A Report on the Properties and Potentialities of Cast Iron" by a joint Committee, etc. Apart from this and some minor mistakes in the bibliography, we have nothing but praise for its contents. They are logical and scrupulously fair. For instance, if we were an engineer we should no doubt first examine page 55 to ascertain what the founder could do in the way of tensile strength. Here a table is given with classified strengths ranging between 9 and 27 tons per sq. in., and these are minimum-acceptance tests. But one has not to read far before one is referred to "the general influence of mass and thermal history of structural make-up." What could be fairer or more convincing to the engineer-buyer or designer? Before this subject is dealt with the reader is introduced to the metallurgy of cast iron, and here a modern angle is given to it. Sulphur (we wish the Americans would not spell it "sulfur") is very intelligently dealt with in contradistinction to the older text-books. For the thermal, electrical and magnetic properties of cast iron, Partridge and Donaldson's work is freely drawn upon, and due credit is given to their fundamental researches. This is not so in the case of some work by F. C. Edwards, reproduced in Fig. 84. As Mr. Edwards' work in correlating design with foundry production is highly esteemed in Britain, we hope this will be acknowledged in any future editions. The data on physical constants are more complete than any yet assembled, but they serve as a reminder that much more work requires to be done.

One of the most interesting phases of this book is the material which has been assembled under the subheading "Mechanical Properties." Apart from the more common ones, the subjects dealt with include stiffness, shock resisting, creep, damping effect, acoustics, sub-normal temperature effect and torsion. A section is devoted to heat-treatment, and included in it is information on softening for machinability—a useful item in any publication of this character. Other sections cover white iron and welding, but the last of all—"Foundry Factors of Importance in the Production of Iron Castings"—is full of "meat" for the designer.

This publication makes all handbooks containing foundry data obsolete. It must be bought by all founders in Great Britain making high-grade engineering castings and distributed by them to their customers, retaining, of course, a copy for themselves. In the States the American Foundrymen's Association is making a reduction in price for quantities, but whether that will hold good for Great Britain we are unaware.

V. C. F.

(*Concluded from previous column.*)

dustry, that the same pattern should be used as a basis. If subsequent experience discloses that other lengths or sections are necessary, correlation with a basic standard is still essential. The fact that a master pattern has been prepared, makes reproductions available at a reasonable price, and less than that at which it would be possible to make one in one's own foundry.

The Patternmaker's Foundry Sense.*

By F. C. Edwards.

"It is a fact that out of every hundred persons born in any epoch, only five at most will be capable of making decisions and giving directions."—G. B. Shaw.

Every pattern is a veritable monument of decision, for which the patternmaker is responsible. Each successive step in the growth of this monument—from nebulous beginnings to the final stage of inspection—calls for appropriate decision. These decisions, moreover, are of infinite variety. Even where the operation savours of the mechanical, as in tool manipulation, positive decision is involved. Such manual dexterity, indeed, is at once the fruition of innumerable decisions and the *Open Sesame* to higher realms of mental activity. By handing over details of his job to the effortless custody of atomatism the patternmaker can the more freely exercise creative thought—the necessity and the glory of his craft.

Directing Principles.

Consider, briefly, some of the principal matters upon which the patternmaker is called upon to give decisions. First, there is the confused crop of questions connected with the interpretation of blue-print, rough sketch, and more or less hazy, verbal instructions. This part of the business, in general, may be compared to the art of living. Success implies the ability to reach satisfactory conclusions from insufficient premisses! Rough sketches are notoriously "wropt in mystery." But the patternmaker is not perturbed by perspective malformations nor enigmatic hieroglyphics; and oft-times he decides when dimensions disagree! Verbal instructions, again, are particularly treacherous things. Here, safety may lie in "instructing the instructor"—that is, in securing definite information by relevant suggestions. For, if the casting "goes down," the cry goes up, "The pattern was not made to instructions"!

Then there is the selection of material. In this matter, the ability to correlate the beginning with the end—and all intermediate stages—is a distinguishing characteristic of the experienced patternmaker. The hall-mark of the novice, by the way, is seen (and felt) as he whittles into shape a super-knot!

Next follows construction—the proper arrangement of material—an art in which vision and organising ability are indispensable requisites. Here, especially in the earlier stages of the largest types of pattern, a very serviceable watchword is "*Festina lente*" ("Hasten, with circumspection"). This phase of the craft bristles with vital questions: Which is the best way of the grain to obviate warping? How to obtain the necessary service strength? Should the pattern be made "in the solid," "boxed-up," "framed and panelled," or "built-up of segments"? Correct decisions are so important here that—to paraphrase the reply of Demosthenes, when asked what were the essentials of oratory—one might safely assert that the first essential of patternmaking is construction, the second construction, and the third construction!

Early Troubles.

Decision is involved, again, in manipulating the varied array of hand tools, which, in their acquisition, keep the young patternmaker's "nose to the grindsone" (for they cost him a little fortune), and, as a reward and memento for seeking their intimate acquaintance, swathe his fingers with bandages and register permanent scars! If the hands are disfigured, however, as a result of these experiences, the brain is invigorated. This way sanity lies: such reiterated stimuli develop a quick reaction—the infallible sign of sense!

The efficient employment of circular and band saws, lathe, planer, etc., provides another host of questions. Here, decisions have to be made in the fraction of a second. A wrong decision may secure a ride in an ambulance—and a finished career!

And there is machining allowance to be considered. This varies with different types of casting, and even in different parts of the same casting. "Too much machining" may be the inspector's complaint, when, on a certain job, the patternmaker has allowed one-eighth of an inch. In another case, half an inch allowance may be insufficient.

The patternmaker must also anticipate costing contraction. This does not only differ with different metals (for which the appropriate rule supplies the stereotyped answer), but differs with different types of casting, where sound decisions imply a modification of rule allowance. Even the soundest decisions, however, are occasionally stultified by the vagaries of contraction. Hence, the unwisdom of expecting micrometer-accuracy in the pattern always to be reflected in the casting.

Then there is the perennial question of camber—the most tantalising "villain of the piece"—whose antics one can scarcely hope to divine without the insight and experience of a Longden, but over which the patternmaker must ultimately secure the mastery—if only by the method of trial—and—error!

Limiting Overheads.

And, above all, cost, as most patterns are accounted too expensive. The patternshop belongs to the "unproductive" group. The patternmaker is universally regarded as a "necessary evil." (Hence, his inferiority complex.) He apologises for his existence, therefore, in manifesting, as an imperative and ever-present consideration, a meticulous economy of time and material. He cannot—like the fabled millwright—make any charge for "knowing how"!

Decisions, decisions all the way! Enough, surely, and to spare, to justify the patternmaker's honourable inclusion in Shaw's gifted "five per cent." But wait! These questions cannot be settled by themselves. They are severally conditioned by the wider question of foundry requirements, with which they are indissolubly associated.

Close at the heels of blue-print interpretation—often, indeed, a *pari-passu* accompaniment, for it presents itself at every turn—is the question of moulding. Where best, if at all, to joint the pattern? Should the job be cored out, or made to "leave its own core"? How is the core to be supported, etc.? Unless such questions are satisfactorily answered in the pre-natal stage of the pattern, it is likely to grow up to be a "thorn in the flesh" of its creator!

Carpenters and Patternmakers.

A humiliating, though pardonable, exemplification of this was once brought home to the works carpenter of a small firm where no patternmakers were employed. This carpenter—a very capable craftsman, by the way—was asked by the manager if he could make a pattern for a certain casting which had been broken in the works. In true Lancastrian style, the carpenter replied, "Ah con an' aw!" Gratuitously adding, "Ther's nowt i' patternmaking!"

Well, the carpenter produced the pattern, or, rather, a nicely-varnished specimen of woodwork, *all in one piece*—exactly like the casting before it was broken. Unfortunately, however, for the carpenter's reputation as a patternmaker, the casting happened to be a typical "three-part" job, necessitating, as a moulding proposition, either a dowelled joint in the pattern, or a core. When the manager (who had some foundry knowledge) saw the exhibit, he asked, very pertinently, "How's that going to come out of the sand?"

Now, the story is a true one. Its recital here is not intended, of course, to disparage the ability of the carpenter, as such. It simply illustrates, and refutes, an all-too-prevalent idea that patternmaking is merely "the shaping of blocks of wood to blue-print instructions"!

"How's that going to come out of the sand?" This is the ever-present query in the mind of the patternmaker. Generally speaking, the response is immediate. Whatever may be the particular aspect of the question, the appropriate answer is usually forthcoming. One may ask: "Whence comes this answer?" Manifestly, it was not vouchsafed to the carpenter, although he probably had a normal development of the five senses, and possessed manual dexterity. In seeking its location, one certainly cannot say: "Lo, here"; or, "Lo, there." For it seems, indeed, to be ubiquitous in the ratiocination of the competent patternmaker.

Blue-Print Interpretation.

Consider, for example, blue-print translation. By some mysterious, psychologic process, the several plane views of the component "build up" on the patternmaker's mental retina as a three-dimensional entity. But, mark this, when the mental concept is complete, it embodies the designer's idea—*plus foundry requirements!* The pattern stands there, plainly visible to the mind of its creator. Here it is jointed; at that point, a tapered coreprint extends downwards, to make a projecting limb mouldable; there, again, is a loose piece held in position by a dovetail; against that vertical face is seen a deviation from the blue-print—a D-shape boss, where the circular one shown on the drawing is incompatible with foundry requirements; the weak, extending member is given strength to withstand the rammer (to save the moulder from himself), by the stout, unvarnished bar (not shown on the blue-print), attaching limb to body, and marked "Stop this off"—in addition to its "zebra stripes." Even coremaking has been taken into consideration, for the coreprint over the lug has been tapered outwards from the pattern. This does not apparently assist the moulder. Reflected in the corebox, however, it facilitates core withdrawal, and thus obviates core distortion, and secures the desired agreement between core and coreprint.

Now, the foregoing sketch is fairly representative. With the exception of the special case beyond the pale of ordinary practice (in which the wise patternmaker solicits the moulder's advice), this "thought-pattern"—structure of subjective art—evolves out of the patternmaker's own consciousness. It grows—independent of all extraneous assistance. There is no appeal to text book; no employment of mathematical formulæ; no mechanical aids. And yet, the patternmaker is not a magician; he cannot "make bricks without straw." He must, surely, possess some well-filled storehouse—or, rather, mental plant, since, within its ambit, its output is, apparently, inexhaustible—for the supply of answers to the hydra-headed query "How's that going to come out of the sand?"

Foundry Sense.

In the author's opinion the key to the competent patternmaker's constructive "magic" lies in the fact that he possesses Foundry Sense. He may have been born with it; he may, by diligence, have acquired it; or he may have had it thrust upon him. Or, most likely, perhaps, he owes its possession to the operation of all three factors. In any case, it indubitably forms part and parcel of his mental equipment. And just as thought-production, in general, depends

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* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. A. Phillips presiding.

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to a very great extent—either directly or indirectly—upon the impressions received by the five senses—sight, hearing, taste, smell and touch—so the patternmaker builds foundry thought into his pattern according to the impressions made by the blue-print upon his Foundry Sense. This, indeed, is the patternmaker's personal prompter—his private judgment seat for all foundry questions.

Foundry sense, in short, may be considered analogous to the sense of beauty, or the moral sense, whence judgments issue almost simultaneously with the perception and intellectual apprehension of the thing in question. Or, again—since the patternmaker must look ahead, anticipate snags, and render innocuous the possible bad judgment of others—Foundry Sense may be compared to the motorist's road sense. And—to continue the simile—just as the operation of these faculties bespeaks the existence of standards of appearance, of conduct, or of traffic probability, so the operation of Foundry Sense similarly denotes the existence in the mind of the patternmaker of a comprehensive system of standards relating to foundry requirements and possibilities.

Foundry Sense, then, being such a vital constituent in the mental life-blood of the patternmaker, it may be asked, "How is this key to competency to be acquired?" Here, again, one may reason from analogy, "just as the sense of beauty, the moral sense, and road sense are developed, respectively, by contact with, and contemplation of, beautiful things, high moral characters and the risks of the road, so Foundry Sense is developed by repeated contact with the foundry and foundrymen: by assimilating—in season and out of season—foundry knowledge. Not to be told what to do, but to find out for himself, should be the constant aim of the young patternmaker. And, in his quest, he must regard nothing as sacrosanct. No section of foundry practice should be beneath his dignity to consider, and none too high for his ultimate grasp. Always he should seek the moulder's viewpoint, and respect it. It will pay him to remember that his *forte* is not to argue, but to listen and consider. This way lies wisdom—and foundry sense.

The actual handling of rammer, trowel, etc., is not perhaps essential from a technical-education point of view. As a means of stimulating real, practical sympathy with the moulder, however, a little "perspiring acquaintance" with the rammer may be of incalculable value. It may serve later on to curb one's wrath—to temper justice with mercy—when, in handling a fragile pattern, the moulder's physical strength proves superior to his judgment!

Improvisations.

Of the many kaleidoscopic operations to be witnessed in the foundry, each yielding its special nutritive element in the evolution of Foundry Sense, two deserve reference here. One is the withdrawal of the pattern from the mould; the other, coring up a complicated job. Consider these in the order stated. A large bedplate pattern, necessitating the use of a crane, is about to be withdrawn. The moulder, finding no rapping plates on the pattern, proceeds to overcome the deficiency by inserting a pointed red-hot iron bar into the most obvious joints! If the maker of that particular pattern happens to be present (as he ought to be), and feels no twinge of conscience on his omission to fit his creation with suitable armour in the way of rapping plates, he certainly has mistaken his vocation! It is next discovered that lifting straps are conspicuous by their absence. Is the moulder nonplussed or worried about it? Not in the least! His phlegmatic temperament (Nature's most useful gift to the foundryman) here bars the escape of nervous energy. He looks around the shop for some strong iron spikes or "wood" screws. These, again, he inserts into the most inviting joints! And who can blame him? Certainly not the patternmaker. After all, he has the mould to make, and to cast—and until the pattern is out, he cannot get the metal in!

As the pattern is withdrawn, the sides of the mould cave in, more or less—thanks to the perfectly "square" edges (correct, of course, to blue-print). The deep-rib impressions similarly reflect the pattern's too complete agreement with the blue-print, in the quantity of loose sand awaiting the moulder's attention. And, what means that torn side of the mould? The explanation is quickly forthcoming, as one examines the pattern. There, snugly ensconced in its position, as fitted by the patternmaker, is the loosely(?)-dovetailed facing which ought to have remained behind in the mould! The dovetail is seen to have been fitted, "not wisely, but too well," and mould moisture has done the rest!

Coring-up Problems.

Next, visualise the process of coring-up a mould. Watch the vertical, non-tapered side of that deep core, as it is lowered into position. Before it is half-way down the mould, it has managed to rub away some of the green-sand guide, and the rubbed-off *débris* is accumulating in the bottom of the print impression. No use lowering it further down! It must be withdrawn; the sand cleaned out of the bottom of the mould; and the core itself "eased" with a file. And watch the moulder perform this "easing" operation. "Might as well take plenty off," he remarks! Seeing the mess he has to clean up because core and coreprint lacked complementary tapers, one nods assent—though inwardly feeling that the punishment of the core is grossly in excess of its crime!

In another case, observe how the shallow coreprint impression—half-an-inch in thickness—at the bottom of the deep mould, fails completely as a guide for that core where the body extends all round, beyond the print. Before the core has reached the print impression, the latter is lost to view. One cannot see through the solid core. This is simply unadulterated, "hit-or-miss" guesswork! The moulder is apprehensive of a crush! He withdraws the core. His suspicions are well-founded. One side of the print impression has been crushed down by the descending, ill-guided core. The mould is repaired, and, as the core is again lowered into position, extra care is taken to secure the required location. It is left at that. The casting might be satisfactory—or, again, it might not! Now, in such a case, the coreprint should be, say, one and a-half inches in depth, and well tapered. Alternatively, the print might be entirely omitted. Better, indeed, without a coreprint, if it negatives the purpose it is intended to serve.

Look at that moulder walking around the mould carrying two, almost identical, rectangular cores. He is mystified! "Which is which—and where?" He first tries one, then the other, in one of the rectangular-print impressions. Neither seems to fit correctly. But his job is to core-up the mould. A convenient file soon smoothes away the difficulty! And so, to cast! What a pity the patternmaker forgot to remove a "corner" off one of the coreprints, and two "corners" off the other, and arrange the core-boxes to suit. The moulder would then have found their respective locations at a glance.

Farther away, a horizontal coreprint is found insufficient to support its core. The moulder proceeds to anchor down the core with long spikes, driven at an angle into the mould. This is rather disturbing—for the mould. And anyway, such makeshift methods do not eliminate the risk incurred with the inadequate coreprint. If this lamely-supported core is, subsequently, wrenched from its moorings by the hydrostatic pressure of the metal, a view of the casting might further develop the young patternmaker's Foundry Sense. He would see that the core had lifted, and would realise that bottom bearing, after all, is not so important as upper bearing for the core. Insufficient core support is usually quite inexcusable. One cannot imagine a better example of the "Penny wise and pound foolish" adage than the too-common practice of skimping coreprint bearing.

With such an environment (not to mention the atmosphere), Foundry Sense soon begins to germinate in the *cerebellum* of the budding patternmaker. And this, of course, whether it is or is not "indigenous to the soil." Its development naturally implies certain "growing pains." Wariness springs from the wormwood of experience. To realise that a minor omission on his part has resulted in a major scrap casting—or a heap of scrap castings—is a tonic second to none for jolting a sluggish Foundry Sense into healthy activity!

Semi-Legal Intelligence!

Consider, briefly, one or two cases taken at random from the author's mental note-book. A steel casting, weighing several hundredweights, was debited to the patternshop because two 3-in. diameter cored holes, which were required by the blue-print to enter the casting four inches, had been cored completely through the casting. The foundry's case was that, since no special corebox was supplied with the job, it was "naturally" assumed that the plain, round cores should cut through. The case for the patternshop was that, as there was no indication on the pattern to show that the cores were required to cut right through, the moulder should have inquired before proceeding. The foundry retorted that the pattern was not "fool-proof," and this, they considered, quite established the guilt of the patternshop!

A non-filleted corner in the corebox, just where the pattern was well rounded, yielded a further scrap casting—and a mental jolt! The nature of the job rendered it difficult to form the fillet in the corebox. The patternmaker "naturally" expected that either coremaker or moulder would take the corner off the core to suit the (to him) very obvious radius on the pattern. But the unexpected happened, and the over-sanguine patternmaker "fell between two stools!" Though he lost the case, however, he gained Foundry Sense!

In another "also-ran" case, the starting point of which the patternshop were guiltily conscious, the foundry—with one of their not uncommon gestures—accepted the blame. A slight protuberance was all that appeared on a grey-iron casting where an important lug was required. This lug, by the way, was loosely skewered on the pattern, and, as is quite common practice, had been varnished black on the back. It appeared that the moulder had not taken the usual precaution to count the number of loose pieces, and the lug in question, being the same colour as the mould, had been overlooked. As the casting was rather hefty, the molten metal had partly consumed the wooden lug. Now, had this loose piece been varnished, say, yellow, on the back, it would have caught the moulder's eye—and thus escaped premature cremation!

A further (apparently perpetual) source of scrap is the interchangeability of dowels in loose pieces. To mention one case only of this kind might be misleading. To speak of all those within one's memory—but a tithe of those forgotten—would take far too long! Here one's experience almost produces a fatalistic attitude: "These things always have happened; and they always will happen!" "The moulder 'naturally' positioned the boss wrong way round. One could not expect him to check its position—that's up to the patternmaker!" Yes, the patternmaker certainly can obviate this. A definitely single orientation may be secured by the simple practice of using dowels of different diameters. (This practice has the additional merit of enabling the moulder to see at a glance "which way round" to position a loose piece.) Nevertheless, even the most expert patternmakers are not infrequently caught napping on this score. The author has no hesitation, therefore, in recommending, as a sound investment for any

patternshop, the gramophone record, "Never permit loose pieces two possible positions!"

Having acquired foundry sense—that is, a working modicum (for none but a congenital idiot ever considers his education complete)—the patternmaker should never tire of giving evidence of its possession. He will find an abundance of opportunity. Patternmaking is a dynamic, not static, occupation. There is no standing still—literally or metaphorically. Change is the order of the day. Where the employment of a certain method would be meritorious under some circumstances, it may, in others, simply be "asking for trouble." Everywhere it is a question of relativity. Certain details—brackets, say, or bosses—may justify the making of a pattern in halves with a dowelled joint; other details, or even a difference in dimensions, may render a solid pattern preferable. This involves differences in taper, a different arrangement of coreprints, etc., since, in the latter case, the body of the pattern is wholly accommodated in the drag, instead (with the pattern in halves) of half in the drag and half in the cope. Some peculiarity in the core, again, may turn the scale in the method of moulding. Facility in coremaking, it must be remembered, should be considered as of equal importance with any phase of moulding proper.

Even the blue-print is not exempt from the beneficial activities of Foundry Sense. "Why not a more generous taper here, a good fillet there, a chambered core instead of an all-drilled hole, to obviate porosity; the union of those bosses in close proximity (where a narrow isthmus of sand, if left to the relentless surge of the molten metal, would place the whole casting in jeopardy)." And so on, to the end that castings may be more and more requisitioned, because of their peculiar simplicity of production, and their reliability in service. In a word, Foundry Sense comprehensively applies to every branch of casting production with which the patternmaker is called upon to deal.

Examples from Practice.

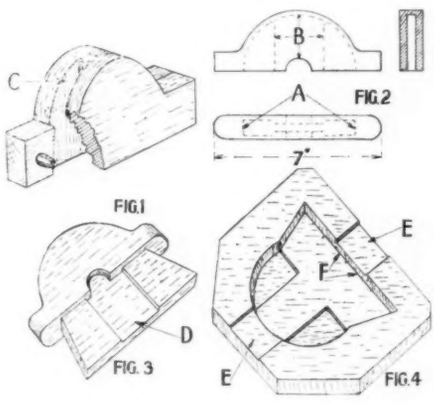
It will be realised that the application of Foundry Sense subordinates tradition to utility. Answering the question "Why?" by the fatuous statement, "I did it because it has always been done that way," invariably rouses the author's ire. Mistakes, of course, cannot always be avoided. But the blind following of precedent is anathema. It argues mental laziness—the unpardonable sin!

"I made it in the usual way," was the answer that evoked an unusual sermon, when the corebox seen in Fig. 1 met the author's astonished gaze. This corebox was intended to produce the core for the casting seen in plan and elevations in Fig. 2. The pattern is shown in Fig. 3. Now the sole purpose of a corebox is to give definite shape to a body of sand. And efficient coremaking means getting the sand into the box quickly, and getting the core out whole. Where the requirements of the casting will permit, therefore, the "open" type of corebox is infinitely preferable to the "closed" jointed type. Hence, the "sermon"! To find that time and materials had been wasted on the corebox seen in Fig. 1, when there was such an ideal alternative as that shown in Fig. 4, caused the author to "go off at the deep end." A virile Foundry Sense rose up in rebellion, and boiled over with justifiable indignation!

Two features—plainly seen in Fig. 2 (which, minus the letters A and B, is a reduced *facsimile* of the blue-print)—rule out the necessity for a jointed corebox. These are (1) the square edges A, in contradistinction to the usual rounded type; and (2) the straight facing B, a welcome variation, again, from the usual semi-circular facing. The corebox shown in Fig. 1 has to be "spoon-fed" through the narrow aperture C; that seen in Fig. 4 takes a bumper supply at one gulp!

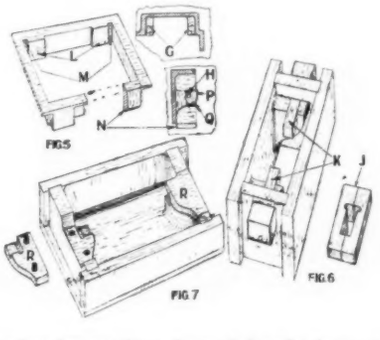
In connection with Figs. 3 and 4, illustrating, respectively, pattern and corebox, it will be seen that the generous "key-stone" coreprint is recessed at D, and the "Foundry Sense" corebox at E. This is a simple method of securing the formation of the internal facing B. It obviates the carrying of a "loose" facing at the top of the box. The coremaker strickles off the rammed-up core, and thus forms the required recess. The non-recessed lower surface of the coreprint (a minor refinement) is reflected in the complementary plain surface, F, in the corebox.

In Foundry-Sense culture there is no finality. Each advance reveals fresh vistas for achievement. Even in the case of patterns which have been in use for a number of years, and which, when made, defied criticism, possible improvements have been known suddenly to manifest themselves under the increasingly powerful lens of cumulative experience—super-foundry sense.



Improving a Frame Casting Pattern.

A case in point is illustrated by Figs. 5, 6 and 7. This example, incidentally, shows how one improvement may pave the way for others. The frame casting seen in Fig. 5 is one of several sizes in constant use, ranging upwards from 3 ft. square. Even a minor improvement, therefore, applied to the whole series, means a major economy. The main purpose of the casting, by the way, is to carry four corner bearings. These bearings, in turn, are enclosed in pockets cored in each end of the frame. A plan of the bearing slots in one of the pockets is seen at G, Fig. 5, and an elevation of the bracket and slot at H. The cores were originally made out of the boxes seen in Fig. 6. The small slot box, J, produced the cores, which were inserted, when dry, in the main core, through the medium of the print impressions formed by the loose pegs, K. Two of the pocket coreprints are seen at L, Fig. 5.



Now, the above method had served to produce some thousands of castings, and, like Tennyson's "Brook," appeared to be "going on for ever." But, one day, it attracted the author's attention, just when he was in the mood for asking questions. "Why tolerate those narrow spaces, M (Fig. 5), between the pocket coreprints and the corners of the frame? They are very troublesome to the moulder, for they require to be carefully 'rodded.' And even when rodded—since the frames are quite twelve inches in depth—there is a great risk of mould disturbance as the pattern is withdrawn. The offending coreprints ought to be removed. Bottom prints—as at N—would serve quite as well. The pocket cores would still have an adequate base area, and would rest against the inside wall of the mould."

Here, a question of design cropped up. It will be seen at P, Fig. 5, that the front edges of the brackets project slightly beyond the inside wall of the frame. These projections (easily accommodated, of course, in the old box) could not be entertained if the coreprints were removed. "But"—questioning again—"are the projections really necessary? Service stress is carried on the brackets at the *base* of the slot; the lip merely holds the steel bearing in position. Surely, it might be levelled off flush with the frame wall?" The author's long-held faith in the good will and sympathy of the drawing office was the *primum mobile* of this reasoning. And his faith was again fully justified. The point in question was immediately conceded.

The removal of the coreprints, L, suggested another improvement. Asking the question "Are the coreboxes satisfactory?" the answer was decidedly in the negative. The pegs, K, in particular, were a constant source of trouble. Their alignment could not be maintained. They were repeatedly replaced, and, as repeatedly wore to a sloppy fit. The harassed foundry could only answer the recurring complaints of the inspection department by promising that "more care would be taken in locating the small bearing cores" (better luck next time!).

In remembering such cases as these (to digress a moment), the author makes bold to suggest that those who are ever ready to pillory the foundryman should keep in mind Schiller's advice, "Man musst mitfühlen ehe man urteilen kann" ("One must sympathise before one can criticise"). No wonder the foundryman occasionally returns a full-blooded expletive when he is goaded with gratuitous invective. As an organism of flesh and blood, he must either become pachydermatous—or perish!

But, to return. "Why be bothered with the small cores? Why not form the whole pocket core in one piece?" To do this it would be necessary to joint the bracket through the slot. Then another question of design presented itself. The rounded "corner" of the bracket was in the way. To joint the bracket through the slot, the corner should be square—as shown hatched at Q—not rounded. (The object of this will become clear later on, when the corebox, Fig. 7, is dealt with.) Admittedly, the rounded "corner" is more æsthetic. But, at this part of the component, good looks count for nothing. Here, again, the drawing office immediately agreed to the proposed modification. These minor alterations rendered it possible to produce a corebox in which the slot cores formed part and parcel of the main core. The alignment, as well as the overall length of the slots, were thus guaranteed. This was a decided achievement. For the steel bars used in the slots were a standard length, and were required accurately to fit.

A glance at the corebox, Fig. 7, will show the object of squaring up the rounded "corner," Q, Fig. 5. This alteration makes possible the use of dowelled loose pieces, R. It is the crux of the job. The joint is taken through the centre of the slot. After the box has been rammed up, the loose pieces are removed, their spaces are temporarily filled with sand, and the core is turned out upon the drying plate. From a coremaking point of view, alone, the method has various solid advantages over the old way. There is a 50 per cent. saving in time; the cores are turned out on the drying plate, and dried, with far less risk of distortion; there are no loose pegs to wear, and to get out of alignment; and no small cores to make, dry, and insert in the large core. The result amply vindicated the questioning activity of foundry sense.

XUM

Repetition Patterns.

The replacement of "standard" patterns (those in constant use) provides further scope for the exercise of foundry sense. Here, indeed, *l'appétit vient en mangeant*. The last word of to-day may inaugurate a new chapter to-morrow. Increasingly, there is the desire to improve. To vary Henry Ford's dictum: A pattern can always be improved upon. A case in point is illustrated by Figs. 8-11. This refers to the production of a light, grey-iron housing, seen in Fig. 8 (torn to facilitate portrayal). As will be understood from the sketch, the bottom of the casting is plated, whilst at the top is an aperture with an internal flange, S. The casting is also open at the side, where the corner lugs, T, are required. These lugs, incidentally, are shown, again, in Fig. 11. The general thickness of metal is one-quarter of an inch.

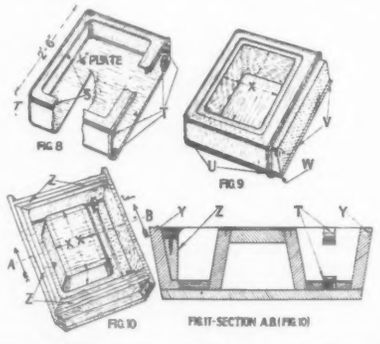
As originally made, the pattern was of the closed, "boxed-up" type, and a plain, rectangular frame, with fixed bottom, constituted the corebox. It should be noted that the blueprint required the vertical sides (as moulded) to be square. Taper, accordingly, was conspicuous by its absence on both pattern and corebox. Now taper is the moulder's best "lubricant." And lubrication here, as elsewhere, is the finest all-round preventive of wear and tear. In the absence of this invaluable prophylactic, rapping becomes a necessary evil. It is necessary in providing the path of least resistance for the removal of the pattern from the mould; and it is an evil, because it is likely to inflict disturbance on the mould and damage to the pattern: it smacks, in a word, of brutality! Since the job was in almost continuous service, therefore, both pattern and corebox soon began to "feature" the effect of the (unavoidably) large doses of rapping. The castings, too—as a natural consequence—increasingly invited uncomplimentary epithets. The author heard these epithets, looked at the castings, and examined the pattern. The epithets—more or less applicable—were undoubtedly justified!

Then Foundry Sense began to "sit up and take notice"! "No taper on pattern or corebox! Why?" "The blue-print does not show any." "But blue-prints do not always mean strictly what they 'say.' Surely some degree of taper is permissible." An appeal to the drawing office secured one-sixteenth of an inch taper in the depth of the job, all round. (Other, related, components rendered an excess of this impracticable.) Even with this taper, of course, some rapping is necessary. The question now is: "How best to confine this rapping to those parts of the pattern where it cannot be reflected in the castings?"

Look first at the old original pattern. The one-time respectable radius all round the top edge, as moulded, had been transformed, by rapping, into a disreputable concatenation of hammer-head bruises. No use blaming the moulder. Such a pattern must be well rapped to get it out of the mould; and the round "corner" is a convenient place to rap. Here the fault lies in the pattern. "Why not remove the round edge out of the way of rapping as the pattern is withdrawn?" This was accomplished by jointing the pattern as shown at U (Fig. 9). A top frame, the same thickness as the radius of the "corner"—an inch and a-half—was made, with the inside panelled to form the quarter-inch plate, at the back of the casting (Fig. 8). Plywood was used for the panel. This frame was dowelled to the body of the pattern, and was lifted off with the cope. No need, now—indeed, no legitimate possibility of mutilating the round "corner." Adequate rapping plates were then screwed into the interior body of the pattern. The loose top plate at the coreprint, it should be observed, was extended over the edge of the main coreprint, as seen at V (Fig. 9). This was done to secure taper in the top coreprint (the reverse of the main print), and still maintain the size at W, required by a continuation of the main coreprint taper. Corebox complications were in this way avoided. In the sketch (Fig. 9) the pattern is shown upside down, as moulded.

A noteworthy feature of the pattern (Fig. 9) is the hollow coreprint, X. This is of especial interest here, since it introduces another field for the profitable cultivation of Foundry Sense—the fettling shop. It has already been mentioned that the pattern, as originally made, was closed in. The core was a plain, rectangular block. Now consider for a moment the removal of this block core from the casting. It is a stony-hard, oil-sand core, and completely fills the casting, which, in contracting, closes upon it with a vice-like grip.

One must remember, also, that the metal in the casting is only one-quarter of an inch in thickness. The fettler is evidently aware of this, for he handles the job very "gingerly." He knows, from bitter experiences, that a blow which would break the enclosed "paving-stone" would certainly fracture the casting. So he taps, nibbles and shakes; shakes, nibbles and taps. Core and casting have become firm friends! The chances of earning a bonus on such a job are hopeless. One grows impatient in merely watching the performance. But one's time is not wasted. For out of the din, dust and turmoil there emerges a peculiarly illuminating fact. One comes to realise that "getting the sand into the box quickly, and getting the core out whole," is not a sufficiently comprehensive philosophy in corebox design. The pattern-



maker's vision must extend to the speedy removal of the core—whole or otherwise—from the castings. One learns, in short, that fettling sense is indispensable to Foundry Sense.

With the above slow and laborious process in mind, then, the author decided to incorporate with the several improvements to pattern and corebox the "frame," or "pie-crust," type of core. Hence, the hollow coreprint, the counterpart of which is seen at XX, Fig. 10. The modification secured an incidental economy of 30 to 40 per cent. of oil sand. It was welcomed by the moulds, because the generously-tapered centre, green-sand cod immediately locates the core. In the fettling shop, the "pie-crust" core scored very heavily over its solid "paving-stone" predecessor. Here, it had replaced dread by delight. A slight tap or two on the print side of the core breaks the continuity of the "pie-crust" frame, and—*presto*, the core is out! And the fettler has secured his bonus!

Next (if one may learn from the classical source—history), glance for a moment at the battered remains of the corebox which is to be replaced. Who can estimate the cash value of the wasted human energy so pitifully represented! For energy has been wasted; it might, easily, have been saved. Admittedly, since the box was almost devoid of taper, much rapping was needed to extricate the core. And most of this rapping was wastefully absorbed by the box itself. Why not make the replace corebox, then, in such a fashion as to render rapping superfluous? Why not give the sides of the box a taper, say, of one inch all round?

Now, there is no occasion for alarm! No change in the casting is contemplated. The modification is confined to the corebox, and the way it is accomplished is illustrated by Figs. 10 and 11. First, an outside frame is constructed, with splayed sides and ends—as seen at Y, Fig. 11—sufficiently large to accommodate the inside loose pieces, Z. The loose slabs are mitred at the corners, and carry aluminium strips to form the round "corners" on the core (previously left to the discretion of the coremaker). At the bottom of the box, hardwood fillets are "worked out of the solid," as shown. Thus, the box forms the core complete.

Coremaking now becomes a comparatively simple operation. With the loose, side slabs in position, the box is filled with oil sand and one or two reinforcement rods. The sand is strickled off level with the top of the box, and the drying plate is applied. The whole is turned over, and the outside frame is lifted off—*without rapping*. The three loose slabs are then separately removed. Pommelling now falls into the "crime" category. Hence, such a box may be expected to outlive a dozen boxes made in the "usual" way.

Conclusion.

And now the question may arise, why this intensive culture of Foundry Sense? Why should the novitiate patternmaker spend "laborious days and anxious nights" in learning his job? Well, this Paper has failed in its object if it has not clearly demonstrated the indispensability of Foundry Sense to the patternmaker. It has also signally failed if it has not at least adumbrated the immensity of the subject. Hence the need for its constant study. "Whatsoever art a man has learned," said Cicero, "let him exercise himself in that art." The famous Roman statesman and orator, one may assume, meant something more than: "*Ne sutor supra crepidam*" ("Let the shoemaker stick to his last"). Rather he stressed the importance to individual and State alike, of proficiency in one's daily occupation. Now, according to Goethe, proficiency is synonymous with pleasure. He held that the mastery of any business was shown by a person's ability to play with it. Which argues, of course, an understanding of one job akin to that "perfect love which casteth out fear." Happy the man whose business yields him pleasure as well as profit. Thrice happy he whose business is not only for himself a congenial as well as a profitable pursuit, but which also provides pleasure—plus profit—for those with whom he is privileged to transact business. That man is a philanthropist *par excellence*. His munificence springs from his personal activities. He does not merely hand on goodness—he creates it. The world is in need of such.

The patternmaker is a potential philanthropist. He is, also, willy-nilly, a philosopher. By *force majeure*, his "high thinking" is harnessed to "plain living." His modest remuneration does not permit him to shower largesse in coin of the realm. The philanthropy at his command is of the superlative kind that issues from performance. In this sphere, he can add to the well-being of mankind. He can assist the foundry industry as a whole; he may cause two castings to grow where one grew previously; he may contribute to his firm's prosperity; he may, indirectly, help his foundry confrère to earn bonus on a "cut" job. And although the chances of securing a profit for himself are microscopic, he will find in the conscientious study of his job the two-fold reward of a duty fulfilled and of a valuable mental discipline acquired. The patternmaker is one of the few art-craftsmen, with assured future, left in the world of industry. The variety of his legitimate accomplishments virtually entitles him to the appellation "University-trained." But his opportunities for intellectual development, his potentialities as philosopher and philanthropist, and, certainly, his chances of attaining happiness—and that "peace of mind which passes understanding"—will come to naught unless, as a patternmaker, he places in the forefront of things worth having, a full and abundant measure of foundry sense.

XUM

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This Week's News in Brief.

Trade Talk.

The offices of Mr. H. A. S. Gothard, consulting engineer, are now at Kimberley House, 14-17, Holborn Viaduct, London, E.C.1.

M. Zarine, the Latvian Minister, made a tour of the works of the Steel, Peech & Tozer branch of the United Steel Companies, Limited, Sheffield, on January 18.

The Import Duties Advisory Committee announce that they are not proceeding with the application previously advertised for the imposition of an additional duty on cast-iron porcelain enamelled baths.

The heaviest steel plate in the history of their works has been rolled by Messrs. Colvilles, Limited, at their Dalzell Steelworks, Motherwell. Weighing almost 22 tons, the plate measured 35 ft. in length, 6½ ft. in breadth, and was 4¾ in. thick.

During last month orders totalling £754,500 were placed, and purchases made by the Soviet trading organisations in Great Britain included £440,500 for machinery and engineering equipment. Messrs. Craven Bros. had orders amounting to more than £63,000.

An order for a 13,400-ton motor vessel to bring food from Australia to the British market has been placed with Messrs. Harland & Wolff, Limited, by the Blue Star Line. The vessel will be built at the Belfast yard, and will be designed for a speed of 16½ knots and specially fitted for the carriage of chilled beef and all classes of refrigerated produce.

The Stein oil-fired rotary melting furnace of 2 tons capacity recently supplied to Messrs. Edward Lucas & Son, Limited, Dronfield, near Sheffield, by Stein & Atkinson, Limited, was started to work a short while ago on grey-iron and black-heart malleable iron. It immediately replaced one 6-ton air furnace, and is proving very economical in operation.

The West of Scotland Association of Foremen Engineers paid a visit to the marine and general engineering works of Messrs. William Beardmore & Company, Limited, at Dalmuir, on January 20. Various groups inspected the plant, and were conducted on a tour through the works, where they inspected the turbine installations and also high-speed Diesel engines of vehicles, locomotives and generators.

Two more Naval contracts have gone to the Clyde. Messrs. Yarrow & Company, Limited, are to build the flotilla leader, H.M.S. "Grenville," and Messrs. Scotts Shipbuilding & Engineering Company, Limited, are to build an "S"-class submarine, H.M.S. "Seawolf." The two contracts are over £1,000,000 in value, and bring the number of naval vessels building on the Clyde to 19, with a total value of over £7,000,000.

It is reported that Motherwell is to have a new industry. The project is stated to be the making on a large scale for home trade and export of a newly-patented safety razor, and also the blades to fit it. The machinery contracts are being dealt with now in Sheffield and elsewhere. It will be recalled that W. M. Wylie, Limited, started the Kismet blade factory in Glasgow; this has been working to capacity since coming into production last summer.

Notable members of the engineering and electrical industries in the West of Scotland attended the dance of the Clyde Crane & Engineering Company, Limited, Mossend, and the British National Electric Company, Newarthill, held in Hamilton on January 19. A company of over 200 included Sir James Lithgow, Bt., chairman of the Clyde Crane Company; Mr. John Jardine, managing director; Mr. George, director; and Mr. Harry Ferguson, general manager of the Clyde Valley Electrical Supply Company.

The contributions to infirmaries and kindred institutions by the employees of Carron Company during 1933 amounted to £1,929 8s. 7d., of which £1,277 10s. 2d. was for Falkirk Royal Infirmary. The employees of other firms contributed as follows: Messrs. J. G. Stein & Company, Limited, Bonnybridge, £170; Messrs. Smith & Wellstood, Limited, £507 5s. 6d.; Messrs. Mitchell Russell & Company, Limited, £202 0s. 3d.; Messrs. Shanks & Company, Limited, Tubal Works, Barrhead, £266; the Blythswood Shipbuilding Company, Limited, Glasgow, £56.

Messrs. G. & J. Weir, Limited, engineers, Cathcart, Glasgow, of which Lord Weir is chairman and managing director, have partially restored the cuts for foremen, clerks and draughtsmen in their employment. Cuts of 10 per cent. were imposed in 1931, and the firm has restored 5 per cent. A similar decision has been taken by Drysdales, Limited, Yoker, an auxiliary firm, which is connected with G. & J. Weir, Limited. Several other Clyde engineering and shipbuilding firms are being approached to restore the cuts for administrative employees, clerks and draughtsmen.

The improvement that has been effected in the foundry trade in Falkirk was mentioned by Mr. J. S. C. Reid, M.P. for Stirling and Falkirk Burghs, when he addressed a meeting in Falkirk last week. The position with regard to unemployment in Falkirk, said Mr. Reid, had improved materially. In fact, it had improved even more in the town than it had done in the country generally. A little over a year ago, he stated, the unemployment figures were alarmingly high. Nearly 30 per cent. of the breadwinners in the town were out of work, but that had been reduced by almost half.

Messrs. A. Reyrolle & Company, Limited, have acquired an interest in the Parolle Electrical Plant Company, Limited, which has been formed with the object of undertaking the construction of electrical power and other works and the acquisition of interests in manufacturing and other undertakings in any part of the world. The Parolle Company has purchased from the executors of the late Sir Charles A. Parsons shares held by him in Messrs. C. A. Parsons & Company, Limited. The authorised share capital of the Parolle Electrical Plant Company, Limited, is £500,000, of which £260,000 has been issued in ordinary shares, and these have been subscribed by Messrs. A. Reyrolle & Company, Limited. The Parolle Company is a private company and its directors are Mr. Norbert Merz and Mr. H. W. Clothier (directors, A. Reyrolle & Company, Limited) and Mr. F. G. H. Bedford (managing director, C. A. Parsons & Company, Limited).

Contracts Open.

Torquay, February 5.—Iron and steel stores and castings, for the Corporation. The Borough Engineer.

Liverpool, February 6.—Brass castings, iron pipes, etc., for the Corporation. The Water Engineer, 55, Dale Street, Liverpool, 2.

London, W., February 28.—Stores, for the Electricity Department of Hammersmith Borough Council. The Chief Electrical Engineer, "Electric House," 154, Uxbridge Road, W.12.

South Africa, February 19.—One two-ton electrically-driven overhead travelling crane, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.Y. 12,181.)

London, S.W.—11 tons of rail braces for 43 kg. rails, two sets of points and crossings for 43 kg. rails, etc., for the Chinese Government Purchasing Commission. Messrs. Sandberg, 40, Grosvenor Gardens, London, S.W.1.

New Companies.

Parolle Electrical Plant Company, Limited, Pilgrim House, Pilgrim Street, Newcastle-upon-Tyne.—Capital £500,000.

Boltons (Metals), Limited, 26, Brown Street, Manchester.—Capital £1,000. Subscriber: V. G. Morgan, 322, Bolton Road, Pendlebury, Manchester.

Electromagnets, Limited, 2, Church Street, Birmingham.—Capital £5,000. Electrical and mechanical engineers. Directors: S. T. Pemberton, E. L. Watson and W. E. Box.

Company Reports.

Leyland Motors, Limited.—Net profit, £20,621; brought in, £93,835; preference dividends, £51,187; dividend on the ordinary shares of 5 per cent., £33,750; carried forward, £29,519.

Herbert Morris, Limited.—Full half-year's dividend to January 31, 1934, on the 6 per cent. (less income tax at 5s. in the £) and the 5 per cent. (free of income tax up to 6s. in the £) cumulative preference shares.

Personal.

Mr. C. Howell Kain informs us that on and after February 1 his address will be "The Elms," Felstead, Chelmsford, Essex.

Mr. J. W. Gardom, of 39, Bennett's Hill, Birmingham, has been appointed technical representative in the Midlands for the sale of "Colbond."

Dr. J. Donald Pollock has been appointed chairman of the board of directors of the British Oxygen Company, Limited, and Mr. P. B. Liversidge chairman of the management committee of directors.

Mr. Oliver Smalley, director of the International Meehanite Metal Company, Limited, addressed a meeting of the Philadelphia Foundrymen's Association recently on "Heat-Treatment of Cast Iron." His address was illustrated with lantern slides and blackboard diagrams.

Mr. Eric Wisbrun, foundry research and consulting engineer, Cleveland, U.S.A., is in Europe, where he will remain for several months. Mr. Wisbrun formerly was connected with the Perfect Circle Company, New Castle, Ind., and the Liberty Foundries Company, Rockford, Ill.

Maj. R. A. Bull has been engaged by the Ajax Electrothermic Corp., Trenton, N.J., U.S.A., to devote part of his time as its consultant and representative in the middle west. Major Bull was director of the Electric Steel Founders' Research group during the 13 years that the organisation was in existence, and is a Past-President of the American Foundrymen's Association.

At the beginning of last week a meeting of the staff of Messrs. J. G. Stein & Company, Limited, Castlebar Works, Bonnybridge, met in the main hall to honour Mr. William Tough on the occasion of his marriage. Col. Alan Stein, M.C., chairman of the firm, in a short but felicitous speech, asked Mr. Tough to accept a grandfather clock as a token of esteem from the staff and as an earnest of their good wishes for his future happiness and prosperity.

As briefly announced in this column last week, to mark the completion of 40 years' service as an official, 21 of which have been spent in the managerial chair, Mr. George Pate, O.B.E., general manager of the Carron Iron Company, has been presented with gifts from the staff and directors. The presentation was made at the annual staff dinner, held in the Dobbie Hall, Larbert, at which 150 heads of departments and under-managers were present. Mr. A. Anderson, furnace manager, asked Mr. Pate to accept a gold wristlet watch from the staff, and Mr. F. L. Burder, senior voting partner and chairman of the company, handed over a silver salver. Both paid generous tribute to the services given to the company by Mr. Pate, who, in reply, expressed his sincere appreciation of the spirit which had prompted the action of the directorate and staff.

Obituary.

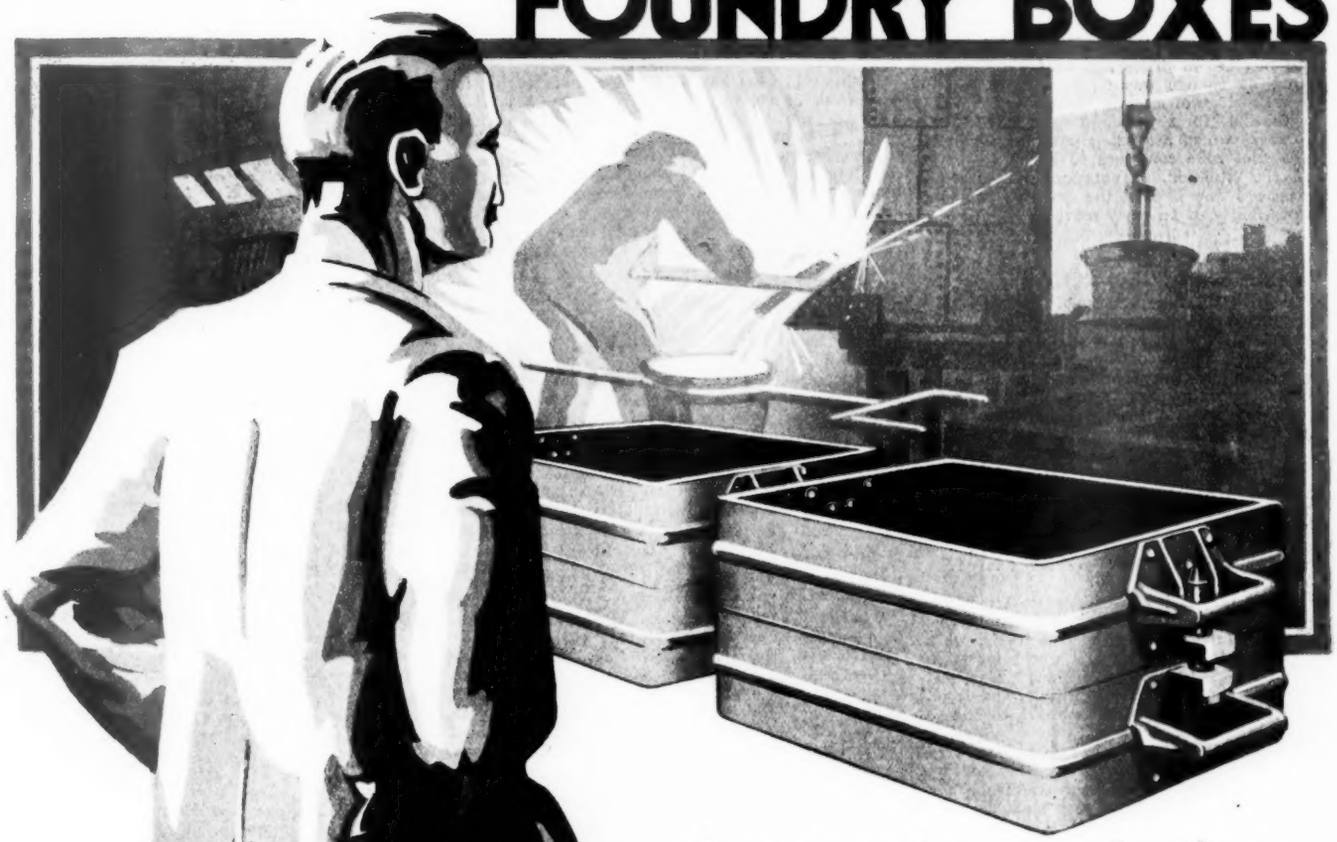
Mr. Edgar Worthington, who was secretary of the Institution of Mechanical Engineers from 1898 to 1920, died on January 23, in his 78th year, at his home in London.

The death occurred at his home in Larbert, on January 23, of Mr. Thomas Hogg. Mr. Hogg, who was in his 62nd year, was in the employ of Messrs. Dobbie Forbes & Company, Limited, Larbert Foundry, for 31 years, but twelve years ago he became associated with Messrs. Jones & Campbell, Limited, Torwood Foundry, Larbert.

Mr. James Andrews, who died on January 21, was well known in Clyde engineering circles, and was the originator of several patents, among the most noted being a balanced-slide valve for steam reciprocating engines. Valves of his design have met with marked success in marine work, and some of the latest steamers built on the Clyde and elsewhere have been fitted with the Andrews valve gear. He was a native of Kilmarnock and set up in business with Mr. D. Cameron in 1904. Two years later they moved to Kirkintilloch, the present headquarters of the firm of Andrews & Cameron. Mr. Andrews was in his 71st year.

The London & North Eastern Railway Company has placed orders for 6,100 tons of English and Scottish pig-iron with 17 firms and for 1,000 tons of steel fishplates with eight British firms.

FOUNDRY BOXES



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Raw Material Markets.

The home demand for pig-iron continues to expand. A general increase in prices had been expected last month, but no change was made. There is still, however, a shortage of material, a shortage which is likely to continue for a while, in spite of the additional furnaces which are being put into operation. The scarcity of coke continues to be an important factor in the situation. Quotations for blast-furnace grades are very high at the moment, and there is little possibility of an early move in a downward direction.

Pig-Iron.

MIDDLESBROUGH.—Quotations for Cleveland iron are still at the levels prevailing for the last twelve months, although a rise had been expected. The demand for supplies continues to exceed the current output, and as the ironmasters have little or no iron in stock, they are restricted to supplying only actual consumers with their immediate needs. The production is being increased, but it will be some time before the leeway is made up. The fixed minima continue to be based on No. 3 G.M.B. at 62s. 6d. per ton delivered Middlesbrough, 64s. 6d. delivered to North of England districts beyond Teesside, 62s. 3d. delivered Falkirk and 65s. 3d. delivered Glasgow. No. 1 foundry is at 2s. 6d. per ton more than No. 3, while No. 4 foundry and No. 4 forge iron are at 1s. per ton less.

The demand for East Coast hematite remains in excess of the supply, but the makers refuse to commit themselves further at the current levels, which are 62s. 6d. per ton f.o.t. makers' works for mixed numbers, and 63s. for No. 1 quality. The merchants are also adopting a firm attitude, and in one or two cases 2s. per ton premium above the official minima has been paid.

LANCASHIRE.—The majority of pig-iron consumers in this district are now covered by contracts for periods ahead, and the producers are in a very satisfactory position. They report that deliveries of iron into Lancashire last month compared very favourably with the totals of either December or November last year. The improvement recently is partly credited to the increase in scrap prices. For delivery to users in the Manchester price zone, current offers of Staffordshire, Derbyshire and North-East Coast brands of No. 3 iron are all on the basis of 67s. per ton, while Northamptonshire iron is quoted at 65s. 6d., Derbyshire forge 62s., East Coast hematite at 76s. 6d., and West Coast at around 80s. 6d. The demand for Scottish pig-iron in this district remains rather quiet, but values seem to be steadier in tone, the current range for delivery in the Manchester area being from 80s. to 81s. per ton.

MIDLANDS.—The members of the Central Pig-Iron Producers met last week, but decided to make no changes in prices. The present minimum Association figures applying to Birmingham and Black Country stations are 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, less rebate to big users. For delivery into consumers' works 7d. per ton extra is charged. Scottish No. 3 is at round about 85s., medium phosphorus pig from 70s. to 80s., and low phosphorus iron from 80s. to 85s. per ton delivered this area. For special work where refined irons are utilised, prices range from £5 15s. to £6 15s. per ton delivered. There is now little Northants iron in stock at the furnaces, but stocks of Derbyshire iron are still considerable.

SCOTLAND.—Scottish pig-iron remains a steady market, there still being a tendency to cover ahead. There is a very strong demand for English iron, but it is almost impossible to purchase supplies, even by offering a premium above the official rates. The official quotations for No. 3 Middlesbrough are 62s. 3d. f.o.t. Falkirk and 65s. 3d. f.o.t. Glasgow, with other English irons quoted at 1s. 3d. per ton less. The price of Scottish foundry iron is unaltered at 65s. at furnaces, with 2s. 6d. per ton extra for No. 1, but an advance is considered very likely.

Coke.

Some of the Welsh coke makers have increased their quotations for delivery in the South Staffordshire area, but there has been no change in Durham coke. Present prices, delivered in the Birmingham area, are as follow:—Welsh foundry coke, 35s. to 47s.; Durham foundry coke, 36s. to 40s. per ton. Most consumers have already bought supplies up till March, and in some cases as far forward as June.

Steel.

Business in steel has fallen off a little during the past week or so, but there is still strong pressure upon the works for delivery. Order-books in most departments of the trade are in a condition to keep the works busy for some time. The demand for semi-finished steel has become quieter, principally because most of the important consumers have made arrangements with suppliers for some months ahead. In the finished-steel department, some irregularity is noticeable in the demand, but the tone of the market is firm.

Scrap.

In the Cleveland scrap-iron market, machinery metal is now quoted at 55s. per ton, ordinary heavy cast iron at 53s. 6d., and light metal still at 49s. There continues to be a steady demand for scrap iron in the Midlands, where heavy machinery metal in cupola sizes is at 55s. delivered, good heavy metal at 50s., and clean light scrap at 42s. 6d. In Scotland, machinery cast-iron scrap is at 56s. 6d. to 57s. 6d., and ordinary cast iron at 54s., light cast iron being firm at 46s. Slightly better conditions are reported in the South Wales market, where heavy cast iron in large pieces and furnace sizes has further improved to 50s. per ton.

Metals.

Copper.—The price of standard copper has stayed at a comparatively high level, but the market has, nevertheless, shown hesitation lately, following upon reports that a further hitch has occurred in connection with the imposing of a "code" upon the United States copper industry. Political upheavals in France have also been a disturbing feature. Generally speaking, however, consumption of copper in Europe is fairly well maintained, and the outlook for the year, particularly as regards this country, is fairly optimistic.

The week's prices have been as follow:—

Cash.—Thursday, £33 8s. 9d. to £33 10s.; Friday, £33 3s. 9d. to £33 6s. 3d.; Monday, £33 15s. to £33 16s. 3d.; Tuesday, £33 13s. 9d. to £33 15s.; Wednesday, £33 11s. 3d. to £33 12s. 6d.

Three Months. — Thursday, £33 10s. to £33 11s. 3d.; Friday, £33 6s. 3d. to £33 7s. 6d.; Monday, £33 18s. 9d. to £34; Tuesday, £33 17s. 6d. to £33 18s. 9d.; Wednesday, £33 13s. 9d. to £33 15s.

Tin.—Actual trading in this metal has generally been featureless during the past week or two. Attention continues to centre on the proposed "buffer pool." It will be remembered that, of the 21,000 tons of tin formerly held by the International Tin Pool, it was announced last autumn that all save 8,000 tons had been disposed of. It is proposed that the latter amount shall be used as a buffer stock "to rule out excessive fluctuations in the market price." Much opposition has been forthcoming, however, to the attempt to place further restrictions upon a market which, it is argued, is already so artificially controlled as to be in strong danger of alienating its consumers.

Daily quotations:—

Cash.—Thursday, £226 10s. to £226 12s. 6d.; Friday, £226 12s. 6d. to £226 15s.; Monday, £226 5s. to £226 7s. 6d.; Tuesday, £226 12s. 6d. to £226 15s.; Wednesday, £226 5s. to £226 10s.

Three Months.—Thursday, £226 7s. 6d. to £226 10s.; Friday, £226 10s. to £226 12s. 6d.; Monday, £226 2s. 6d. to £226 5s.; Tuesday, £226 7s. 6d. to £226 10s.; Wednesday, £225 15s. to £226.

Spelter.—There has yet to be an improvement in the demand for galvanised products, but the other zinc-consuming industries are fairly busily engaged. The demand for spelter has been slow lately, and it is felt that buyers have been hanging back in the hope of a lower price. There has been some pressure to sell by holders.

Price fluctuations:—

Ordinary.—Thursday, £14 18s. 9d.; Friday, £14 16s. 3d.; Monday, £14 16s. 3d.; Tuesday, £14 17s. 6d.; Wednesday, £14 16s. 3d.

Lead.—Business in lead has also been hanging fire this week. The prevalent uncertainty in international affairs has affected the market, and buyers have been holding back, waiting to see which way prices will move. At present, values are fairly stable.

Daily market prices:—

Soft Foreign (Prompt).—Thursday, £11 12s. 6d.; Friday, £11 11s. 3d.; Monday, £11 11s. 3d.; Tuesday, £11 10s.; Wednesday, £11 6s. 3d.

Book Reviews.

Metallurgical Analysis by the Spectrograph.—D. M. Smith, A.R.C.S., B.Sc., D.I.C. 1933. British Non-Ferrous Metals Research Association, London. 10s. 6d. net.

The application of spectrographic methods to the every-day analysis of metals and their alloys is a comparatively recent development, although the principles of spectrography have been well known for many years. During the last few years, however, the possibilities of metallurgical spectrography have been carefully explored by the British Non-Ferrous Metals Research Association, whose investigations have indicated that spectrographic methods can not only afford valuable help by providing a means of obtaining rapidly qualitative information regarding the constituents of alloys, but also they are likely to be very useful in supplying qualitative data regarding minor constituents and impurities.

As a result of these investigations, methods have been developed for the estimation of certain impurities in zinc, tin, lead and copper, and descriptions of these methods, together with much general information on the subject, are given in the book written by Mr. Smith, and recently published, under the title given above, by the British Non-Ferrous Metals Research Association.

In order that accuracy may be obtained, it is essential that the methods adopted for quantitative analysis should be rigidly standardised, and to this end precise details of the apparatus used and the methods employed are given by the author.

It would appear that spectrography is best adapted to the estimation of constituents and impurities present in amounts less than 1 per cent., and that under these conditions an accuracy of about ± 10 per cent. of the amount present can be obtained.

There is little doubt that, in many cases, spectrographic methods of analysis are likely to be of considerable value in dealing with metals, and Mr. Smith's book will be very useful to those wishing to adopt such methods. In making public the results of their investigations, the British Non-Ferrous Metals Research Association have adopted a broad-minded policy, on which they are to be congratulated.

J. H. G. M.

Mechanical World Year Book, 1934.—Published by Emmott & Company, Limited, 31, King Street West, Manchester. Price 1s. 6d. net.

This edition shows that a real effort has been made to place before engineers some of the new developments of metallurgical research, especially in the field of cast iron. The ideal (from the foundryman's point of view) has not yet been reached, but the engineer must now be impressed with the notion that cast iron is not a material yielding nine to twelve tons tensile, but a wide range of alloys displaying a variety of excellent properties. A new section has been added which deals with machine tools from a fresh angle, and a further one on parts pressed from sheet metals. As usual, the Year Book contains the vast amount of standard data.

MESSRS. BRANDEIS, GOLDSCHMIDT & COMPANY, metal merchants, 9-13, King William Street, London, E.C.4, have sent us a copy of their Annual Metal Report for 1933. Within the convenient size of 32 pages, it contains comprehensive reviews of world market conditions throughout last year as regards the four base metals, with all the necessary statistics. It also offers the buyer of metals a sound survey of the factors which are likely to influence prices during 1934.

Genuine All-Mine Cold Blast Pig Iron - - - - - -

PERFECT FOR HEAVY CASTINGS

FOR CHILLED ROLLS, CYLINDERS, CYLINDER LINERS, COG WHEELS FOR ROLLING MILLS, BOTTOM PLATES FOR MORTAR MILLS, AND ALL HIGH GRADE CASTINGS REQUIRING UNIFORMITY, DURABILITY, STRENGTH OR TOUGHNESS AND RESISTANCE TO GROWTH UNDER HEAT.

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FAMOUS FOR CENTURIES

RAW MATERIALS—PRICE LIST.

(Wednesday, January 31, 1934.)

COPPER.

	£	s.	d.
Standard cash	33	11	3
Three months	33	13	9
Electrolytic	36	10	0
Tough	35	5	0
Best selected	35	15	0
Sheets	62	0	0
India	45	0	0
Wire bars	37	5	0
Ingot bars	37	5	0
H.C. wire rods	39	15	0
Off. av. cash, December	31	6	11 13/19
Do., 3 mths., December	31	9	5 13/19
Do., Sttlmnt., December	31	6	11 13/19
Do., Electro, December	34	14	2 10/19
Do., B.S., December	34	1	11 3/19
Do., wire bars, December	35	1	10 5/19
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8⅜d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7⅜d.
Rolled metal	7d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5⅜d.
Do. 4 × 3 Sheets	5¾d.

TIN.

	£	s.	d.
Standard cash	226	5	0
Three months	225	15	0
English	227	0	0
Bars	228	5	0
Straits	231	7	6
Australian (nom.)		—	
Eastern	229	15	0
Banca	231	2	6
Off. av. cash, December	227	14	10 8/19
Do., 3 mths., December	227	15	7 17/19
Do., Sttlmt., December	227	14	5 13/19

SPELTER.

	£	s.	d.
Ordinary	14	16	3
Remelted	14	15	0
Hard	12	5	0
Electro 99.9	17	0	0
English	15	10	0
India	14	0	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., December	14	16	6 3/19
Aver. spot, December	14	18	10 7/38

LEAD.

	£	s.	d.
Soft foreign ppt.	11	6	3
Empire	11	15	0
English	12	15	0
Off. average, December	11	8	7 5/19
Average spot, December	11	10	10 3/38

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex whse.	23	5	0
Rods	28	15	0

ANTIMONY.

	£	s.	d.
English	37 10 0 to 40	0	0
Chinese, ex-whse.	26	10	0
Crude	20	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	9	0	0 to 9 7 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	6 10 0
45/50%	13 0 0
75%	18 2 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	2/6 lb.
Tungsten metal powder—	
98/99%	2/9 lb.
Ferro-chrome—	
2/4% car.	32 0 0
4/6% car.	23 0 0
6/8% car.	21 12 6
8/10% car.	21 12 6
Ferro-chrome—	
Max. 2% car.	34 10 0
Max. 1% car.	35 12 6
Max. 0.70% car.	37 10 0
70% carbon-free	10½d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt, 98/99%	5/6 lb.
Metallic chromium—	
96/98%	2/8 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{1}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	15	0 to	2	17	6
Bundled steel and shrngs.	2	2	6 to	2	16	0
Mixed iron and steel	2	10	0 to	2	12	6
Heavy cast iron				2	10	0
Good machinery	2	10	0 to	2	12	6
Cleveland—						
Heavy steel				2	16	0
Steel turnings				1	15	0
Cast-iron borings				1	5	0
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	13	6 to	2	15	0
Midlands—						
Light cast-iron scrap				2	2	6
Heavy wrought iron				2	15	6
Steel turnings, f.o.r.				1	13	6
Scotland—						
Heavy steel	2	13	6 to	2	15	0
Ordinary cast iron				2	14	0
Engineers' turnings				2	2	0
Cast-iron borings				2	0	0
Wrought-iron piling				2	12	6
Heavy machinery	2	16	6 to	2	17	6

London—Merchants' buying prices, delivered yard.

Copper (clean)	27	0	0
Brass	20	0	0
Lead (less usual draft)	10	15	0
Tea lead	8	0	0
Zinc	10	0	0
New aluminium cuttings	68	0	0
Braziery copper	25	0	0
Gunmetal	25	0	0
Hollow pewter	150	0	0
Shaped black pewter	106	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/-
Foundry No. 3	62/6
,, at Falkirk	62/3
,, at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	63/-
Hematite M/Nos., f.o.t.	62/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	70/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/-
,, No. 3 fdry.	66/-
Northants forge	58/6
,, fdry. No. 3	62/6
,, fdry. No. 1	65/6
Derbyshire forge	62/-
,, fdry. No. 3	66/-
,, fdry. No. 1	69/-
Scotland—	
Foundry No. 1	67/6
,, No. 3	65/-
Hem. M/Nos. d/d	66/-
Sheffield (d/d district)—	
Derby forge	59/6
,, fdry. No. 3	63/6
Lincs forge	59/6
,, fdry. No. 3	63/6
E.C. hematite	76/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	80/-
Clyde, No. 3	80/-
Monkland, No. 3	80/-
Summerlee, No. 3	80/-
Eglinton, No. 3	80/-
Gartsherrie, No. 3	80/-
Shotts, No. 3	80/-

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	0	0 to	9	15	0
Nut and bolt iron	7	0	0 to	7	15	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.			12	0	0	
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.	13	15	0			
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	5	0 to	8	15	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)	7	12	6 to	8	5	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	0	0 to	12	10	0
Hoops (Staffs)	10	10	0 & up.			
Black sheets, 24g. (4-t. lots)			10	5	0	
Galv. cor. shts. (,,)			12	15	0	
Galv. flat shts. (,,)			13	5	0	
Galv. fencing wire, 8g. plain			14	0	0	
Billets, soft	5	10	0 to	5	15	0
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	0	0 to	5	10	0
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	11½d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	19.26
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	18.50
Basic, Valley	17.00
Bessemer	19.76
Malleable, Valley	17.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	26.00
Sheet bars	26.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	1.89
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.60
Steel hoops	1.85
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.35
Plain wire	2.20
Barbed wire, galv.	2.85
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	25/- to 27/6
,, furnace	17/6 to 18/-
Durham foundry	21/- to 25/-
,, furnace	18/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		16/3 to 16/6
,,	28×20	,,	32/6 to 33/-
,,	20×10	,,	23/6 to 23/9
,,	18¾×14	,,	16/10½ to 17/-
C.W.	20×14	,,	14/9 to 14/10½
,,	28×20	,,	30/9 to 31/-
,,	20×10	,,	21/9
,,	18¾×14	,,	15/3

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Jan.	25 ..	33	8	9	dec.	7/6
,,	26 ..	33	3	9	,,	5/–
,,	29 ..	33	15	0	inc.	11/3
,,	30 ..	33	13	9	dec.	1/3
,,	31 ..	33	11	3	,,	2/6

Electrolytic Copper.

		£	s.	d.		
Jan.	25 ..	36	0	0	dec.	20/–
,,	26 ..	36	0	0	No change	
,,	29 ..	36	5	0	inc.	5/–
,,	30 ..	36	10	0	,,	5/–
,,	31 ..	36	10	0	No change	

Standard Tin (cash).

		£	s.	d.		
Jan.	25 ..	226	10	0	dec.	20/–
,,	26 ..	226	12	6	inc.	2/6
,,	29 ..	226	5	0	dec.	7/6
,,	30 ..	226	12	6	inc.	7/6
,,	31 ..	226	5	0	dec.	7/6

Tin (English ingots).

		£	s.	d.		
Jan.	25 ..	227	0	0	dec.	25/–
,,	26 ..	227	5	0	inc.	5/–
,,	29 ..	226	15	0	dec.	10/–
,,	30 ..	227	5	0	inc.	10/–
,,	31 ..	227	0	0	dec.	5/–

Spelter (ordinary).

		£	s.	d.		
Jan.	25 ..	14	18	9	dec.	1/3
,,	26 ..	14	16	3	,,	2/6
,,	29 ..	14	16	3	No change	
,,	30 ..	14	17	6	inc.	1/3
,,	31 ..	14	16	3	dec.	1/3

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Jan.	25 ..	17	5	0	inc.	2/6
,,	26 ..	17	2	6	dec.	2/6
,,	29 ..	17	0	0	,,	2/6
,,	30 ..	17	0	0	No change	
,,	31 ..	17	0	0	,,	,,

Zinc Sheets (English).

		£	s.	d.	
Jan.	25 ..	24	10	0	No change
,,	26 ..	24	10	0	,, ,,
,,	29 ..	24	10	0	,, ,,
,,	30 ..	24	10	0	,, ,,
,,	31 ..	24	10	0	,, ,,

Lead (English).

		£	s.	d.	
Jan.	25 ..	13	0	0	No change
,,	26 ..	13	0	0	,, ,,
,,	29 ..	13	0	0	,, ,,
,,	30 ..	13	0	0	,, ,,
,,	31 ..	12	15	0	dec. 5/–

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898	2 7 6	2 8 0	2 8 0	2 8 0	2 8 6	2 10 0	2 10 0	2 10 0	2 10 0	2 11 0	2 14 0	2 14 0	2 9 11
1899	2 13 0	2 14 0	2 14 0	2 14 0	3 0 0	3 2 0	3 13 0	3 16 6	3 15 0	3 16 6	3 16 6	4 0 0	3 6 2½
1900	4 0 0	4 0 0	4 0 0	4 1 6	4 1 0	3 18 0	3 13 6	3 12 6	3 11 0	3 11 0	3 9 6	3 8 0	3 15 5
1901	2 13 6	2 17 0	2 15 0	2 15 0	2 14 0	2 13 9	2 13 6	2 13 6	2 14 6	2 13 0	2 12 6	2 16 6	2 14 3½
1902	2 17 6	2 17 6	2 15 6	2 16 9	2 16 6	2 16 6	2 16 6	2 17 0	2 18 6	2 18 6	2 17 6	2 17 6	2 17 1½
1903	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1904	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1905	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1
1906	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	3 0 8½
1907	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2
1908	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 0	2 12	2 12 6	2 13 5½
1909	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0½
1910	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1911	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 14 6	2 15 0	2 15 0	2 15 8½
1912	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1913	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1914	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	2 18 2
1915	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1916	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6½
1917	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6½
1918	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1919	4 12 6	4 12 6	4 12 6	4 12 6	7 2 6	7 5 0	8 8 5	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	7 3 10
1920	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	13 1 3	14 7 6	14 5 0	14 5 0	14 5 0	12 12 1½
1921	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 17 10	8 0 2
1922	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 13 7
1923	4 12 8½	5 0 2	6 2 6	6 8 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1924	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	4 10 0	4 10 3	4 17 9½
1925	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	3 13 4½	3 13 2½	4 1 9
1926	3 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	•	•	•	•	4 12 6	4 0 1
1927	4 13 9½	4 13 3	4 11 1½	4 9 4½	4 6 1½	3 19 1½	3 16 1½	3 15 6	3 13 4½	3 13 4½	3 14 0	3 13 6½	4 1 6
1928	3 13 2½	3 12 3½	3 12 3	3 12 3	3 11 6	3 10 0	3 8 3	3 7 8½	3 7 6	3 7 9½	3 8 3	3 7 6	3 9 10
1929	3 8 3½	3 10 4½	3 10 10½	3 11 0	3 11 2½	3 12 0	3 12 4½	3 14 6	3 15 1½	3 17 0	3 17 0	3 17 0	3 13 1
1930	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 15 0	3 12 0	3 12 0	3 12 0	3 10 1½	3 9 6	3 14 4
1931	3 9 6	3 9 6	3 9 6	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 10
1932	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1933	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1934	3 7 0	—	—	—	—	—	—	—	—	—	—	—	—

• No prices available during strike period.

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Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

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